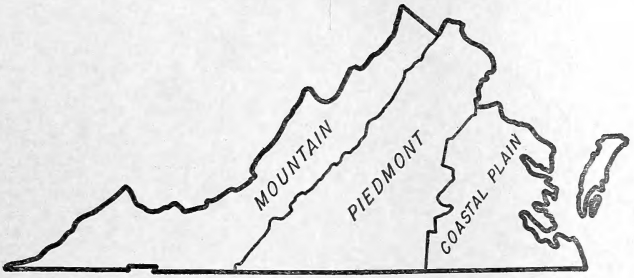
Virginia

FOREST RESOURCES AND INDUSTRIES



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VIRGINIA FOREST RESOURCES AND INDUSTRIES

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The Forest Survey

WORLD WAR II proved that timber is one of the indispensable resources of the United States. Postwar demands for housing, paper, and other forest products both at home and abroad have further emphasized the need for abundant timber resources and for dependable information concerning them.

One-third of the Nation's productive land is available for and suited to the growing of timber. Maintenance of ample timber supplies on this vast area is both a public and private responsibility. This involves long-time planning and a reliable knowledge of forest conditions and forest-products requirements. Authentic facts must be gathered concerning the location and condition of existing and prospective forests and forest lands, depletion and growth, and present and probable future requirements for forest products. To obtain such facts, Congress by the McSweeney-McNary Forest Research Act of May 22, 1928, authorized the Nation-wide Forest Survey.

The fivefold purpose of the survey is: (1) To determine the extent, location, and condition of forest lands, and species, quantity, and quality of timber on these lands; (2) to ascertain the current and probable future productivity of forest areas; (3) to determine the quantity of timber cut for industrial and domestic uses, and the losses from fire, insects, disease, suppression, and other causes; (4) to ascertain the present and probable future trend in requirements for forest products by all classes of consumers; and (5) to interpret these findings and correlate them with other economic factors as a basis for formulating public and private policies for effective and rational use and management of land suitable for forest production.

Results of the Forest Survey are published in a series of reports that aim to supply general information for a long-time program of planning for timber production and some detailed information of use in guiding forest-industry development. In this appraisal no attempt is made to evaluate the use of forests for watershed protection, wildlife, recreation, or grazing even though such services of the forest are often of paramount importance.

The information presented here is applicable to Virginia and to major physiographic provinces within the State; it furnishes the background for intensive studies of critical situations, but it is not designed to reflect conditions by counties.

RAYMOND D. GARVER,
Director, Forest Survey.

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Summary of Survey Findings

FORESTS rank high among Virginia's rich and varied natural resources. They have a significant influence on the welfare of agriculture, industry, employment, water supplies, game and fish, and recreation. But their contribution to the people of the State is only a fraction of what it could be under better forestry and closer timber utilization.

VIRGINIA'S FORESTS

SUPPORT A LARGE FOREST-PRODUCTS INDUSTRY. Some of Virginia's largest industrial plants use wood as raw material, and small wood-using industries are scattered throughout every county. In 1939 the products of these 2,700 plants were valued at about $123,000,000, of which about $54,000,000 was the value added by manufacture. Wood products ranked third in value among all manufactures. The wood-products industries rank next to textiles as a source of industrial employment, accounting for 22 percent of all employees in manufacturing. Commercial forest industries provided nearly 40,000 man-years of employment in 1944.

In 1942 the lumber cut was 1.2 billion board feet, placing Virginia eighth in the South and eleventh in the Nation in lumber production. In 1945 the cut was 995 million board feet. Nearly one-half the lumber was produced by small, generally portable mills cutting less than 1 million feet a year, two-fifths by mills cutting from 1 to 5 million feet and a little more than one-tenth by the nine larger mills.

Veneer production required 29.3 million board feet of logs in 1945 of which 10.7 million feet was brought in from adjoining States. Exports to neighboring States totaled 1.3 million feet.

The State's nine pulp mills have a daily capacity of over 1,770 tons of pulp and in 1945 purchased 823,500 standard cords of wood of which nearly three-fourths was pine, and the remainder gum, yellow-poplar, chestnut, and oak. In 1945 these and out-of-State mills obtained 798,900 cords of pulpwood from Virginia.

Cooperage plants totaling 63 produced principally nail-keg staves; but potato-barrel, tobacco-barrel, and whiskey-barrel staves were also manufactured. Total wood used for cooperage in 1945 was 76,900 cords. More than one-third of the Nation's excelsior plants are located in Virginia, where 30,000 cords of pine were consumed for this product in 1945. Miscellaneous manufactured products accounted for an additional 30,900 cords of various species. In 1945, 3.3 million cords of wood were used for fuel, one-fourth of it cut from sound living trees.

In 1945 saw-timber drain was 1,223 million board feet, of which 719 million feet was softwood, and 504 million feet was hardwood. Nearly one-half the saw-timber drain came from loblolly and shortleaf pine. Of saw-timber drain, lumber accounted for 75 percent, pulpwood more than 11 percent, fuelwood 6 percent, and all other products 8 percent.

Total drain from the growing stock was 4.7 million cords, of which 2.6 million cords was softwood. Of total drain, 57 percent was used for lumber, 18 percent for fuelwood, 15 percent for pulpwood, and 10 percent for other products.

OCCUPY 58 PERCENT OF THE TOTAL AREA OF THE STATE. Forests cover 14.8 million acres, of which 14.4 million are commercial timberland.

More than one-half of this commercial forest land is on farms; nearly nine-tenths is in private ownership. In 1940, 46 percent of the forest area was occupied by the upland hardwood type, while the bottom-land and cove hardwood types together covered an additional 11 percent. The loblolly pine, shortleaf pine, and Virginia pine types each occupied about 2 million acres, or 14 percent each, of the forest area. The white pine type was limited to little more than 200,000 acres.

CONTAIN 7 PERCENT OF THE SOUTH'S SAW TIMBER (fig. 1). In 1940 the live saw-timber volume was 24.3 billion board feet, or 1.5 percent of that in the Nation. One-half of the live volume was softwood. Loblolly pine made up 29 percent of the total, with 7 billion board feet. There was then

standing 758 million feet of dead chestnut. The average volume per acre of all saw-timber stands was 3,250 board feet, and for all forest land was only 1,690 board feet. Nearly one-half of the saw-timber area bore stands averaging less than 1,200 board feet per acre.

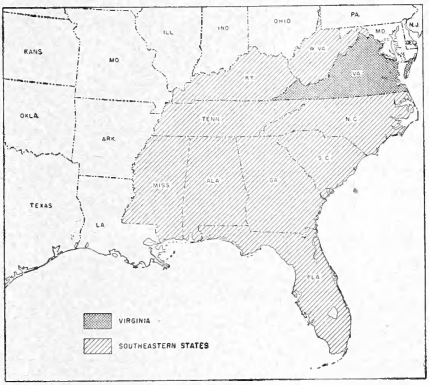

FIGURE 1.—*Location of Virginia in relation to the "South," as used in this report.*

In 1940 the total volume of all sound material in trees 5 inches in diameter breast high and larger was 205 million cords. More than two-thirds of that volume was hardwoods. Loblolly pine, white oak, shortleaf pine, chestnut oak, and yellow-poplar were the most abundant species. Fifteen percent (29 million cords) of the total sound volume was in cull trees, 90 percent of it hardwood species in light demand.

ARE INCREASING IN VOLUME. The total volume of saw timber increased 7 percent between 1940 and 1946, while the volume of all timber increased 11 percent. Hardwoods increased about 15 percent both in saw timber and in all timber. Softwood saw timber showed little change but there was a 5-percent increase in all softwoods when the smaller trees were included. Among the softwoods, the shortleaf saw timber decreased, while Virginia pine, a less valuable species, increased. In the Piedmont shortleaf pine decreased by 450 million feet but a 327-million-foot increase in Virginia pine partially compensated for this loss, so that the net reduction was only 4 percent. In the Coastal Plain and mountains there was little change. Among the hardwoods, about one-half the saw-timber increase was made up of the gums and yellow-poplar. The gums are generally of good quality in the Coastal Plain, but are not particularly desirable for lumber on the uplands. Measured in cords, total softwoods, all sound trees 5 inches d. b. h. and larger, increased for this period 3,292,000 cords. Hardwoods increased 12,984,000 cords.

In 1945 net saw-timber increment was 1,744 million board feet, of which 923 million board feet was softwoods and 821 million feet was hardwoods. The saw-timber growing stock increased at the rate of 7 percent. Total net increment in 1945 was 8.4 million cords, or 3.8 million cords of softwoods and 4.6 million cords of hardwoods. Average net increment per acre was 121 board feet of saw timber, or 0.6 cord of all growing stock.

Mortality from all causes was equal to 5 percent of gross growth. The principal causes are insects, disease, and fire.

ARE VERY POORLY STOCKED. On almost one-half of the forest land classed as saw timber, the board-foot volume per acre averages about 1,200 feet. In one-fourth of the counties the average stand per acre is only 830 board feet.

One-half of the State's forest land in 1940 bore saw-timber stands, 45 percent bore cordwood stands, and the remaining 5 percent, including approximately 19,000 acres not restocking, was classed as reproduction. Pine stands in the Coastal Plain were only one-half stocked, and in the Piedmont they were slightly less stocked. Hardwood stands in the mountains averaged only one-third stocked.

HAVE 15 PERCENT OF THEIR VOLUME IN CULL TREES. Too much forest land is occupied by poorly formed trees of limited merchantability. Aggregating 29 million cords in total volume they take the place of more productive trees on the equivalent of at least 2 million acres of commercial forest land.

ARE GRADUALLY BEING CONVERTED TO HARDWOODS. In the past 6 years hardwood saw timber has increased 15 percent while the pine saw timber has remained practically constant. This is serious because good-quality hardwoods are generally cut too heavily, with the result that most of the hardwood increase is in poor-quality trees and the less wanted species. The effect is a gradual deterioration in stand quality.

CONTAIN SPECIES WHICH ARE OVERCUT. The most noticeable case of overcutting occurred in the shortleaf pine of the Piedmont, which was reduced in volume by 450 millon board feet in 6 years, a decrease of 23 percent.

ARE UTILIZED WASTEFULLY. In 1944 the net waste resulting from logging and milling in the primary forest industries was 134 million cubic feet.

This is equivalent to nearly one-fourth of the net annual growth.

NEED BETTER PROTECTION. Although all of Virginia's forest land is now under organized protection, the loss of usable timber due to fire, insects, disease, and other causes is still large. Annual losses exceed one-half million cords—a volume about three-fifths as large as the requirements of the pulp industry.

CAN PRODUCE LARGER YIELDS OF TIMBER. The average net annual increment for all commercial forest land was only 121 board feet per acre. This is largely a result of poor stocking and rather extensive areas of low-quality sites in the Piedmont and mountains. With intensive management on the fair sites and only simple protection on the poorest sites, it is estimated that net annual growth could be increased in three to four decades by at least 25 percent. This would increase the net annual growth from 1.7 billion board feet to 2.2 billion board feet.

HAVE UNREALIZED POTENTIALITIES. There is enough commercial forest land in the State to produce more than adequate timber supplies for its wood-using industries, provided the land is well managed. A united effort of all organizations and individuals—local, State, Federal, and private—will be required to improve the forest situation substantially. Best oportunities for doing this seem to lie in building up the forest-land volume and quality by constructive forestry practices, better protection against fire, insects, and disease, and improved utilization. Aids and services to private owners, public purchase of lands not suited to private holding, adequate research to find methods of improving the growing, harvesting, and marketing of the forest crop, and possibly some measure of control of cutting on private lands are ways of utilizing these opportunities.

The State: Its Environment and Resources

STRETCHING westward 432 miles from the Atlantic Ocean to the famous Cumberland Gap on the Kentucky State line, the southern boundary of Virginia separates the Old Dominion from North Carolina and Tennessee. From that boundary the State extends a maximum of 200 miles northward to Maryland. The total area of Virginia is 40,815 square miles, of which 916 square miles is water. The land area is 25,535,360 acres.

Physiographic Provinces

Three major physiographic provinces characterize the State (fig. 2). The Coastal province, one-fourth of the land area of the State, contains 6,362,900 acres. It extends inland approximately 125 miles from the coast and about the same distance from the Potomac to the southern boundary. Elevations range from sea level up to 300 feet on the western boundary. The area lying between the coast line and the range of high tide in the major watercourses is known as the Tidewater, where elevations seldom exceed 50 feet. Four major rivers break the northern and central part of the region into three long peninsulas, and a fourth peninsula, the Eastern Shore, is separated from the rest by the broad waters of Chesapeake Bay. This combination of tidal rivers and the Bay has provided excellent harbors which contribute to the prosperity of the region. While most of this area has been farmed at some time during its more than 300 years of occupancy, cultivated fields are now generally restricted to the more productive sandy loam and light sandy soils which can be farmed indefinitely with proper fertilizing and soil-conserving measures (fig. 3). In 1940 only 29 percent of the area was in use for crops and improved pasture, 62 percent was forested, and the rest was in towns and other miscellaneous uses.

West of the Coastal Plain lies the Piedmont province, containing about two-fifths of Virginia's land, or a little more than 10 million acres. It extends 250 miles from northeast to southwest across the State and varies in width from 50 miles on the Maryland line to about 150 miles at the North Carolina border. The

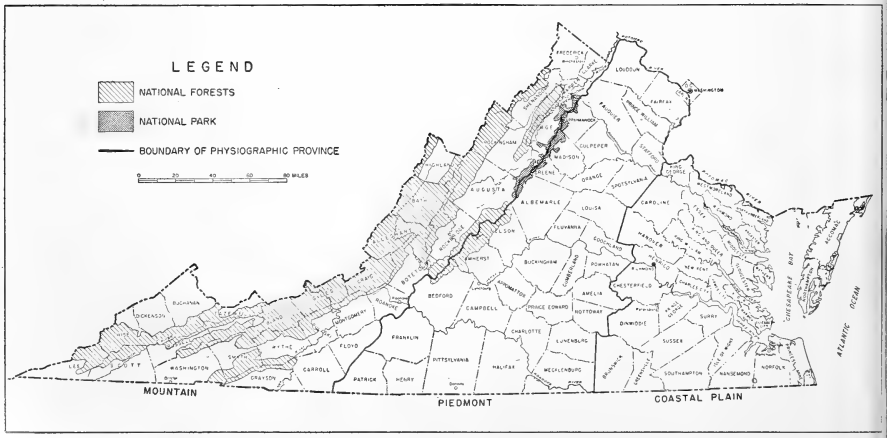

FIGURE 2.—*Physiographic provinces, counties, principal rivers, and national forests and parks in Virginia.*

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FIGURE 3.—*Crops and pastures are confined to the better soils of the Coastal Plain and occupy less than one-third of its area.*

topography is gently rolling adjacent to the Coastal Plain but becomes progressively more rugged as the mountains are approached (fig. 4). Elevations range from 300 feet on the east to between 500 and 1,000 feet at the base of the Blue Ridge. The soils, originally fertile, have lost much of their productive capacity through severe erosion and heavy cropping, and large areas are now clearly submarginal for farming. In 1940, 37 percent of the land was in use for crops and pasture, 59 percent was forested, and the remainder was in other uses.

Three well-defined formations comprise the Mountain province: the Blue Ridge Mountains, the Appalachian Valley and Ridges, and the Appalachian Plateau. The Blue Ridge, forming the eastern boundary, is a narrow ridge at the north but widens into a high rugged plateau toward the south, where Mount Rogers, 5,719 feet above sea level, constitutes the highest point in the State. The upper slopes and ridges of the Blue Ridge are forested; the lower slopes and valleys are devoted to pastures, orchards, and crops. West of the Blue Ridge lie alternating broad valleys and narrow ridges of the Valley and Ridges formation—chief of which is the Great Valley of Virginia, extending sothwesterly from Winchester to Bristol. Here the ridge tops and steeper slopes are forested (fig. 5), but most of the land is used for pasture and orchards. The soils are chiefly of limestone origin, and very fertile. Along the western boundaries of the State is the Appalachian Plateau, consisting of the eastern escarpment of the Cumberland and Alleghany Mountains, a region of rugged, broken topography, narrow valleys, and sharp ridges. It is 70 to 80 percent forested. The Mountain province as a whole contains 9,106,000 acres, of which 54 percent is forested, 24 percent is pasture, 18 percent is cropland, and the rest is in miscellaneous uses.

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FIGURE 5.—*In the mountains the upper slopes and ridges are forested; the lower slopes and valleys are devoted to pastures and crops.*

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FIGURE 4.—*The rolling Piedmont is characterized by interspersed blocks of forest, pasture, and cropland. Tobacco is an important crop.*

Natural Resources

The principal natural resources, other than forests, are the soils, minerals, and water. Game and fish, especially commercial fisheries, are also important.

The soils (*6*, pp. 125–129)[1] vary widely over the State, from highly fertile clay loams to nearly sterile sands. In the Coastal Plain, the Norfolk, Ruston, and closely associated soils predominate. These soils have loam or sandy loam surface soils and subsoils varying from sandy clay loams to heavy clays. While possessing little natural fertility, these soils respond readily to application of commercial fertilizers. Agricultural

[1] Italic numbers in parentheses refer to Literature Cited, p. 55.

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crops grown are peanuts, cotton, tobacco, and corn. Over considerable areas near the coast, drainage is too poor for agricultural production, and these areas will probably remain in forest. Forests also occur in extensive blocks on the higher soils throughout the province.

Piedmont soils are chiefly of the Cecil-Appling group, with associated Durham, Appalachian, and Louisa soils. Originally fertile, they have been deteriorated by severe sheet and occasional gully erosion and by poor cropping practices. Over large areas they are now more valuable for timber than for crops. Tobacco, corn, wheat, oats, vegetables, and fruit are the principal agricultural products. The typical land use pattern is an intermingling of crop, pasture, and forest land—all in relatively small blocks. Extensive areas of forest are much less common than in either the Coastal Plain or the mountains.

The soils of the Blue Ridge portion of the Mountain province are chiefly the Porter-Ashe and associates. They are friable and inherently fertile but climate and topography restrict crop production. A self-sufficing farming system characterizes the area. Corn, wheat, burley tobacco, and fruit are principal crops. Livestock are an important source of farm income. In the Great Valley, the principal soils are the Hagerstown, Frederick, and associates, chiefly of limestone origin. These soils are dominantly silt loams and clay loams and are highly suitable for pasturage and fruit. Apples in the north and livestock in the south are the principal farm products. The soils of the Appalachian Plateau are mostly the De Kalb, Leetonia, and Claymen. All of these soils, and especially the predominant De Kalb, are stony, frequently intermingled with rough, broken bedrock. Farming is of the dairy or general-farm type but most of the area is forested.

Virginia's chief mineral resource is coal, mostly bituminous, but with smaller amounts of semibituminous and semianthracite. Original deposits are estimated at 32.5 billion tons. Production in 1941 was 18.4 million tons of coal and 325,000 tons of coke, valued at $44,840,000. Coal and coke provided 63 percent of the value of all minerals produced in the State in that year, products such as stone, sand and gravel, clay, clay products, and zinc accounting for the remainder. The total value of all mineral production in 1941 was $71,341,000 (*6*, pp. 152–156). Coal production is localized in three areas: In the Piedmont near Richmond; in the southwestern Valley near Marion and Pulaski; and, the principal area, in the Appalachian Plateau in extreme southwestern Virginia.

Water, both surface and ground supply, is one of the most important resources of the State, and has contributed markedly to its development. The upper reaches of the major streams and their headwater tributaries provide water power and their tidal portions afford a major artery of transportation. Precipitation retained in the soil and rocks as ground water provides for maintenance of stream flow and for well supplies. "Virginia's feasible, undeveloped water power is estimated to be sufficient for an output of 4.5 billion kilowatt-hours annually" (*9*, p. 2). In 1944, the total hydroelectric output of the State was 579.5 million kilowatt-hours, or less than 13 percent of potential capacity. The 1944 output, however, represented an increase of 18 percent since 1937. In 1944, hydroelectric plants provided 16 percent of the total production of electrical power in the State (3.6 billion kilowatt-hour) (*7*, p. 65; *9*).

Use of water for domestic and industrial purposes in the State is dependent on impounded surface waters, base stream flow, natural springs, and both deep and shallow wells. In the Mountain province most towns depend on small reservoirs or natural springs; in the Piedmont and Coastal Plain the larger cities depend on reservoirs or direct river intakes, while the smaller communities in general use deep wells. Since water shortages exist in the southern Piedmont and Tidewater communities dependent on wells, more impounding reservoirs are needed. Quality of the surface and spring waters in the mountains is generally high, that of the Piedmont and Coastal Plain surface waters is low, requiring extensive treatment for both domestic and industrial use. Full use of the potential water resources of the State is dependent on wise land use on all the major watersheds in order to minimize soil erosion and excessive runoff, the forerunners of silting and floods. Wise land use obviously implies conservation management on both forest and farm properties.

Social and Industrial Conditions

Virginia's economy is well balanced between agriculture and industry. For the State as a whole, farm production is well diversified. Industrially the State ranks third in value of manufactured products among the 12 States of the South,[2] being exceeded only by Texas and North Carolina. In 1939, Virginia produced 13 percent of the value of all manufactured goods in the South, her products being valued at 989

[2] Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

million dollars. Transportation is generally adequate; power development is expanding. Population growth has averaged 10 percent per decade since 1890. Forest resources are reasonably abundant and diversified, and their utilization is an important segment of Virginia's economy.

Population and Employment

In 1940 Virginia's population numbered 2.7 million people, roughly two-thirds of whom were classified as rural and one-third as urban. Nearly 37 percent of this total lived on farms. Urban-population increase has averaged 18 percent per decade since 1920, but rural population increased at a rate of only 3 percent per decade in the same period. Undoubtedly this trend toward increased urbanization was even more accentuated after 1940, as a result of war industrialization. Postwar trends have not yet been reported.

In March 1940 about 933,000 Virginians were employed in normal activities not classified as public emergency work. By occupation they were distributed as follows: Agriculture 25 percent, manufacturing 20 percent, wholesale and retail trade 12 percent, professional services 6 percent, transport and utilities 7 percent, and miscellaneous occupation 30 percent. One-fourth of those engaged in manufacturing were employed in the forest-products industries.

Agriculture

In 1940 Virginia's 174,885 farms contained 16,445,000 acres, an average of 94 acres per farm. There were only 688 farms of 1,000 acres or more, but 22,291 were of less than 10 acres each. The 94-acre average farm had 39 acres in woodland, 27 acres in crops, 18 acres in plowable pasture, and 10 acres in other uses.

The total value of farm products sold, traded, or used in 1940 was about 151 million dollars. Seventy percent of this income came from the sale or trade of livestock and livestock products, including poultry, and from farm crops, chiefly tobacco and fruit. Most of the rest of the value represented products used on the farm. The value of farm woodland products sold and used cannot be accurately determined from recent statistics. On the basis of a questionnaire survey made jointly by the Forest Service and the Bureau of Agricultural Economics in 1937, it is estimated that their value was about 15.5 million dollars. Considering that at that time there were about 6 million acres of farm woodland, the average return per acre was very low, only $2.60. It must be recalled, however, that many acres were not operated at all and that the realization of the income on the woodlands which were operated required little expense other than the value of the owner's own labor or that of his hired farm hands. Even this low income, however, represented more than 10 percent of the value of all farm products in 1940. Comparing the 15.5 million dollars of forest products in 1937 with 1940 farm-product values, only livestock, livestock products, corn, tobacco, hay and forage, and vegetables sold and used on farm had a higher value.

An arresting fact about Virginia's agriculture is that a large proportion of the farms yield incomes that permit the operators and their families only the barest necessities. The 1939 census reports that the value of all farm products sold, traded, or used was less than $400 for 44 percent of the farms, and less than $600 for 61 percent of the farms. These meager incomes are, of course, supplemented by off-farm labor income. Thirty-five percent of all farm operators reported that they worked off their farms for an average of 170 days each during 1939. Assuming a daily wage of $4, this would gross only $680 per year.

Since half of the State's forest area is on farms, improvements in managing and harvesting the farm woodlands can play a vital part in the welfare of the forest industries and of the State as a whole.

Manufacturing

Pronounced industrial development has taken place in Virginia since the turn of the century. During this period (1899–1939) value of manufactured products has increased to nine times the former value, and value added by manufacture to seven times the former value. The number of wage earners has increased from 66,000 to 134,000 and wages from 20 million to 116 million dollars. There have also been some striking shifts in type of industry. Those producing capital goods have been replaced to a considerable extent by those producing consumer goods, chiefly textiles and food products. Manufacture of cigarettes and of smoking and plug tobacco has long been a major industry.

In 1939 the 2,579 manufacturing establishments reported by the United States census employed 134,000 wage earners and produced goods valued at nearly 989 million dollars. The textile and apparel industry had the most employees, followed by wood products (fig. 6), and food products (fig. 7, *A*). In value of products, however, the tobacco industry was far in the lead, providing 36 percent of the value of all goods produced. Textiles, wood products, and chemical products each provided about 13 percent of total product value (fig. 7, *B*).

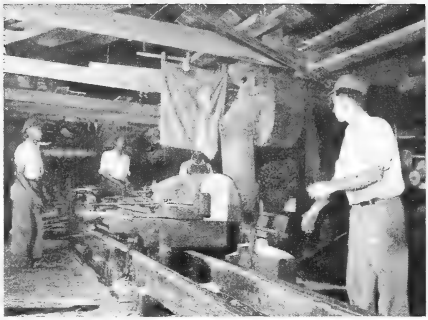

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FIGURE 6.—*In 1939 Virginia's forest industries provided employment for 30,000 persons. This is one of the State's many small sawmills.*

Value added by manufacture is in many respects the most satisfactory index of relative importance of industries. In 1939, value added in the State was 379.5 million dollars. Textiles and textile products comprised about 25 percent of this amount. Tobacco products ranked second, and wood products third (fig. 8).

The tremendous industrial expansion during the war years had perhaps a greater influence on Virginia's manufacturing than anything occurring during the preceding two decades. Detailed data are not available, but by 1943 the number of wage earners had increased to 216,000 and wages had more than tripled, totaling 383 million dollars. Some of this increase has already been lost since the end of the war, but, barring major deflation in the economy, many of the gains, particularly in higher wages, will be retained.

In 1939 the average annual wage in all manufacturing industries in Virginia was $867. Among the major industries, the chemical industry paid the highest average wage, followed closely by the paper and pulp industry, both paying in excess of $1,000 per year. Lowest average annual wage, less than $700, was paid in the lumber and timber industry, and in furniture factories. Needless to say, all wage levels are much higher today. In 1943 the average annual wage in all industries was $1,492, *excluding* overtime pay, an increase of 72 percent over 1939. Wages in wood-product industries increased to slightly over $1,000, a raise of about 50 percent (*5*).

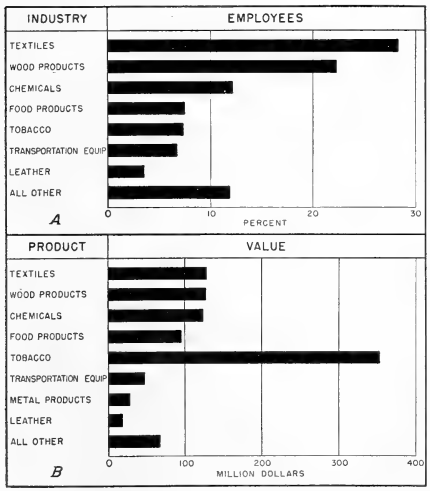

FIGURE 7.—*A, Proportionate number of employees in manufacturing industries, and B, value of products manufactured in Virginia, 1939.*

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FIGURE 8.—*In 1939 the value added by manufacture to the State's forest products totaled about 54 million dollars.*

Three industries in the State that depend primarily on wood or wood cellulose as basic materials have had exceptionally rapid growth during recent years. Between 1919 and 1939, the furniture industry increased the value of its products from 5 to 31 million dollars. In the 1930's, pulp and paper products increased from 21 to nearly 51 million dollars, and rayon and allied products from 28 to 60 million dollars.

Transportation

While a good transportation system is requisite to the adequate functioning of all segments of a region's economy, it is particularly necessary for the utilization

of a forest resource that is spread thinly over many acres, and whose products are heavy and bulky, are often handled many times between stump and the final product, and may be consumed hundreds of miles from their origin. In the early days of lumbering in Virginia, the waterways and rough "tote" roads were the principal arteries of transport for both logs and lumber. Later improved roads and railroads supplemented the interior waterways. Today trucks are increasingly important in moving logs, lumber, pulpwood, and the host of finished wood products, but they have not replaced railroads or water shipment. Virginia has a good transportation system which utilizes highways, railroads, and waterways.

Land Use

When the first colonists stepped ashore at Jamestown in 1607, all of Virginia save the tidal marshes, the rock outcrops on the higher mountains, and the scattered Indian clearings was forested. In the more than three centuries which have since elapsed, the utilization of timber and the clearings for agriculture and towns have greatly reduced the forested area, but 58 percent of the State, 14,832,300 acres, is still forest land (fig. 9), of which all but 420,300 acres is commercial (table 1).[3]

[3] Since 1940, the commercial forest area has been decreased by 35,000 acres withdrawn on national forests for recreational use. (See table 2.)

Forest-Land Use

In 1940, commercial forests were growing on 14,412,000 acres, or 56.5 percent of the land area of the State—an area exceeding by more than 5 million acres the total acreage in cropland and pasture. Less than 19,000 acres was not restocking. The relative extent of this and other classes of timberland was as follows:

	Percent
Saw-timber stands	50
Cordwood stands	45
Young reproduction	5
Clear-cut areas	Negligible
Total	100

TABLE 1.—*Land area classified according to use, 1940* [1]

Land use	Distribution of total area	
	Acres	*Percent*
Forest:		
Commercial	14,412,000	56.5
Public reserved	235,900	.9
Noncommercial	184,400	.7
Total	14,832,300	58.1
Nonforest:		
Cropland	5,954,700	23.3
Abandoned cropland	380,100	1.5
Pasture	3,424,300	13.4
Marsh	272,500	1.1
Other	671,500	2.6
Total	10,703,100	41.9
All uses	25,535,400	100.0

[1] Data obtained by Forest Survey.

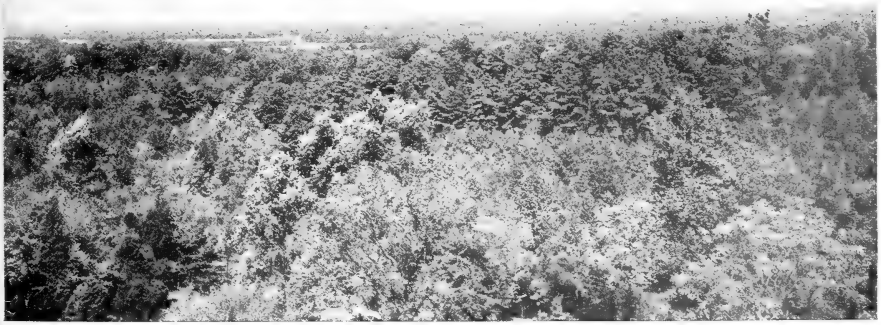

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FIGURE 9.—*Nearly three-fifths of the State's area is still forest land.*

Forests are generally considered as chiefly valuable for timber production; yet they provide other services which in total may oftentimes equal or exceed their value for timber products. Among these are recreational use, watershed production, game and fish production, and grazing use. It is perhaps a unique attribute of forests that in many cases several or all of these services can be combined successfully with commercial timber production without seriously depleting the growing stock or the soil.

Virginia's tourist trade is "big business." In 1941, income from tourist and vacation trade exceeded 100 million dollars. Just how much was spent by visitors to the State's forests and forest parks is unknown, but the Shenandoah National Park attracted, in prewar years, an average of 1 million visitors annually. The recreational facilities established by the George Washington and Jefferson National Forests were visited in 1941 by 336,000 people. Use decreased during the war, but even in 1945 these 2 national forests had 93,000 visitors. The 6 State parks and 4 State recreation areas attracted another 100,000 or more people in the last prewar year. Postwar use is rapidly increasing. Hence, the forests are an important attraction for recreation seekers and tourists and aid materially in augmenting the income from these sources (fig. 10).

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FIGURE 10.—*Forest land and waters are an important asset to Virginia's 100-million-dollar tourist business.*

Watershed protection is a valuable function of forest land, particularly in the mountains and also on the more rolling land of the Piedmont. The two national forests were established under the terms of the Weeks law of 1911, authorizing the purchase of forest land on the headwaters of navigable streams. Forest land on their steep slopes and those of the Shenandoah National Park helps to reduce erosion, decreases rate of storm runoff and resulting flood crests, equalizes the flow of streams, and maintains a higher level of ground water for wells and springs. Both national forests provide domestic and industrial water for numerous communities and for many hydroelectric plants (fig. 11). Several municipalities in both the

F-441843

FIGURE 11.—*National forests protect the headwaters of streams providing hydroelectric power and municipal water supplies.*

TABLE 2.—*Ownership of forest land, 1945* [1]

Ownership	Area	Commercial forest	Total forest
Commercial areas:			
Public:	*1,000 acres*	*Percent*	*Percent*
National forests	1,266	8.8	8.5
State forests	60	.4	.4
Other public	234	1.6	1.6
Total	1,560	10.8	10.5
Private:			
Farm woodlands	7,621	53.0	51.4
Nonfarm:			
Under 5,000 acres	4,248	29.6	28.6
Over 5,000 acres	[2] 948	6.6	6.4
Total	12,817	89.2	86.4
All commercial	[3] 14,377	100.0	96.9
Noncommercial areas:			
Public reserved:			
National forests	129	----	.9
National parks	214	----	1.4
State parks	26	----	.2
Total	369	----	2.5
Other noncommercial [4]	86	----	.6
All noncommercial	455	----	3.1
All ownerships	14,832	----	100.0

[1] Based, unless otherwise noted, on 1945–46 Reappraisal by U. S. Forest Service.

[2] Estimated by State forester, 1944.

[3] Commercial forest area decreased between 1940 and 1945 because 35,000 acres on national forests were withdrawn for recreational use.

[4] Land too poor to support commercial timber stands.

mountains and the Piedmont maintain forested watersheds. In view of the serious water shortages now prevalent in the Piedmont and, to a lesser extent, in the Coastal Plain, it seems apparent that watershed management on forest lands has not been sufficiently widespread or thorough, particularly in the headwater portions of the State's drainage basins.

The sharp increase in numbers of beef cattle since 1940 has been accompanied in parts of the State by greater use of forest land for grazing. This movement has been greatest in the Coastal Plain, where it is combined with commercial timber production. The bulk of the cattle production in Virginia, however, is on improved pasture in the Upper Piedmont and mountains, particularly in the Great Valley, where woods grazing is at a minimum.

Forest-Land Ownership

Exact data on forest-land ownership are not available, but the latest estimates indicate that about 89 percent of the total commercial forest area is in private hands. Farm woodlands make up 53 percent, and other small nonfarm holdings (less than 5,000 acres each) comprise 30 percent. Larger private holdings, chiefly corporate, total about 1 million acres, or 6.6 percent (table 2). Of the public commercial forests, the largest part is in national forests. The noncommercial forest area is largely in public ownership also, much of it belonging to the United States in the Shenandoah National Park, in smaller historical parks, and in the national forests. The noncommercial area shown in table 2 as "other noncommercial" (86,000 acres) is that reported by the Forest Survey as being too poor, because of soil or other site conditions, to support commercial stands of timber. Much of it is rock outcrop and severely burned areas in the spruce type on high ridges in the Alleghany and Blue Ridge Mountains, some of it within national-forest boundaries, the rest in private hands.

Of the 950,000 acres of large nonfarm private holdings, a considerable part is in the Coastal Plain, owned by lumber and pulp companies. Another part is in the hands of insurance companies, banks, and estates. The latter group of owners also control a considerable proportion of the tenant-operated farms, with their woodlands, throughout both the Coastal Plain and Piedmont.

The Forest Resource

Early History

THE first permanent settlement of colonists in Virginia, at Jamestown in 1607, was founded in part because of England's desperate need for masts, ship timbers, and naval stores. Long dependent upon a precarious supply of these products from the Baltic countries, she found it imperative to discover new sources or suffer loss in naval strength, and hence in world power, among the nations. Consequently she welcomed the opportunity in the New World to " . . . help ourselves out of Virginia . . . ," and to relieve ". . . the great and pitiful waste of our English woods . . ." (*1*). It is not surprising, therefore, that in 1608 a ship is reported to have returned to England bearing "pitch, tarre, clapboard, and waynscot," (*2*) and that in 1609 a cargo of "fower score" masts was exported to the mother country.

Although large quantities of timber were used by the colonists or exported during the next several decades, these uses had little effect upon the forests in comparison with the wasteful process of tobacco culture that developed shortly after the colony was founded. Faced with producing an export commodity that would yield the highest profits to the English proprietors and provide for themselves necessities that a primitive country could not offer, the colonists quickly turned to tobacco culture. This crop soon came to dominate colonial agriculture because it best could stand the long journey and high transportation costs. It continued to dominate for more than a century despite the fact that planters could count on only 3 or 4 seasons' yield from land before the soil became excessively depleted. Thus was set in motion a cycle of land clearing, cropping for a few years, abandonment, and reversion to pine forests, that was extremely wasteful. George Washington remarked that "We ruin the lands that are already cleared and either cut down more wood if we have it, or emigrate into the western country . . . a half, a third, or even a fourth of what land we mangle, well wrought and properly dressed, would produce more than the whole under our system of management; yet such is the force of habit, that we cannot depart from it." Thus, until the middle of the nineteenth century, agricultural development rather than industrial or local use was the principal cause of forest exploitation.

Nevertheless, use of the forests for timber was not entirely neglected. It is probable, though not proved, that the first sawmill in America was operated at Jamestown in 1608. Captain John Smith in his History of Virginia, advising the colonists to "remove this usurping growth," nevertheless noted that it "might itself be converted into a source of wealth." For the first 150 to 200 years almost all lumber mills were small sash-saw affairs powered by waterwheels and were perforce located near sources of water power. The output of a mill of this type probably did not exceed 2 to 3 thousand feet a day, and they operated only infrequently. It was not until the introduction of steam-powered circular-saw mills about 1820 that any considerable exploitation of the forest began, and not until after the Civil War, with the extension of steam railroads over the State, that the real harvest of the State's virgin timber took place. Large band mills then replaced many of the small circular mills.

Lumber output reached its peak in 1909, when Virginia produced 2.1 billion board feet, a figure never approached again. By the time of the outbreak of World War I most of the virgin pine and better hardwoods had passed through the mills, forcing the industry to depend on the periodic yield of second-growth timber, for which the large band mills were not suited. These mills have largely been replaced by a host of small circular-saw, gasoline- or steam-powered, portable mills, from which the bulk of production now comes. Because of the State's suitability for timber growth, second-growth stands have restocked almost all of the cut-over lands, although the quality of the growth is frequently inferior to that of the original forest.

As has been noted, "pitch and tarre" were among the earliest exports of Virginia. In colonial times such exports for the use of "His Majesty's Royal Navy" were an important forest product. Virginia, however, lacked the stands of longleaf and slash pine from

which modern naval stores are extracted, so the naval stores industry never assumed the importance it did farther south.

Present Importance

Her present forest resource is one of Virginia's most valuable assets. The 1940 stumpage value [4] of the saw timber was about 129 million dollars, of which 72 million dollars was in softwoods and 57 million dollars in hardwoods (fig. 12). Loblolly pine provided 35 percent of the total and the oaks 21 percent. The current value is probably almost double that of 1940, because of marked increases in stumpage prices, and the slight increase in total saw-timber volume. As indicated previously, the value of farm-forest products sold and used on farms is about 15 million dollars per year.

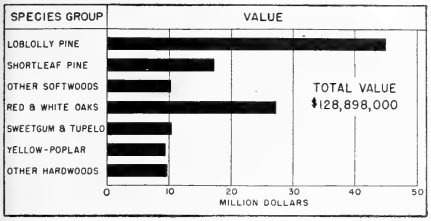

FIGURE 12.—*The stumpage value of saw timber, 1940.*

In 1942, about 2,750 primary wood-using plants obtained their raw material from the forests. In 1944 the primary forest industries employed 21,000 wage earners, and an additional 18,500 workers in the woods getting out the raw material for these plants.

Virginia's forests are also a valuable part of the regional and national economy. The State has 8 percent of the commercial forest area and 8 percent of the total volume of wood in the South. Virginia has 3 percent of the Nation's commercial forest area, and produces 5 percent of the total net annual growth of saw timber in the Nation. In 1944 the State ranked sixth in the South and eighth in the Nation in lumber production, and was exceeded only by North Carolina in the number of operating sawmills.

Forest Description

Except for a few small tracts in the Coastal Plain (fig. 13, *A*) and mountains (fig. 13, *B*), largely in private estates or public preserves, this State's forests are now second-growth timber. As is to be expected in a State covering 25.5 million acres, ranging in elevation from sea level to 6,000 feet, her forests contain a wide variety of species, some extending from the ocean to the mountains, others confined to limited areas peculiarly adapted to that one species. Each physiographic province has a definite pattern of forest cover, each differing distinctly and characteristically with respect to predominant forest types, age, volume per acre, and cutting history.

Species [5]

Loblolly pine makes up 18 percent of the total cubic-foot volume, followed by shortleaf pine, white oak, "other red oaks," Virginia pine, and yellow-poplar.

In the Coastal Plain loblolly pine is the most prevalent species, growing both in pure stands and in mixture with other pines and hardwoods. In total cubic-foot volume, it is four times greater than sweetgum, the next commonest species. Sweetgum grows best in the river bottoms but also grows, though to smaller size, on some of the better sandy loams of the flatwoods and middle Coastal Plain. Blackgum, third most important single species, occurs in both swamps and bottom lands throughout the province. The red oaks as a group are more prevalent than blackgum, as is the white oak group. Both are widespread throughout all parts of the Coastal Plain, growing with pines or with other hardwoods.

Originally the oaks and hickories were the dominant species in the Piedmont. Over the years probably three-fifths of the Piedmont was farmed and eventually abandoned. Scattered shortleaf and Virginia pines reseeded these abandoned fields more quickly and completely than the hardwoods, and the Piedmont forest was gradually transformed from hardwoods to pine, chiefly shortleaf and Virginia. In recent years, the increased demand for pine pulpwood, saw timber, stave bolts, and excelsior bolts has halted the transformation. The cutting out of the pine from old-field and natural stands has led to a hardwood invasion which may in time, if present cutting practices continue, again make the Piedmont a predominantly hardwood area. The red and white oaks are the most prevalent hardwood species. They make up a third of the total cubic-foot volume in the province, slightly exceeding the volume of shortleaf and Virginia pines combined. Yellow-poplar, gums, and

[4] Based on stumpage value per thousand board feet and volume of species composing total saw-timber volume, both as of 1940.

[5] For a list of species with their common and scientific names, see Appendix, p. 58.

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FIGURE 13.—*Virgin timber stands are few, but occur sparingly, A, in the Coastal Plain loblolly type; and B, in the mountain hardwoods.*

hickory are the other important hardwood species. Commonly the natural forest stands of the Piedmont are mixed pine and hardwood; old-field stands are either pure pine or pine-hardwood, the latter generally inferior in both composition and quality.

The mountain forests are predominantly hardwood, four-fifths of the total cubic-foot volume being in this species group. Chestnut oak is the predominant species, followed by "other red oaks" (scarlet, southern red, black, and pin oak), and white oak. The oaks as a group contain about one-half of the total cubic-foot volume. Yellow-poplar and hickory are the other principal hardwood species, although a great many species are present. Of the softwoods, pitch and shortleaf pines are the most prevalent, followed by Virginia pine and white pine. Other less abundant softwoods are hemlock, redcedar, and a small amount of red spruce on the highest peaks.

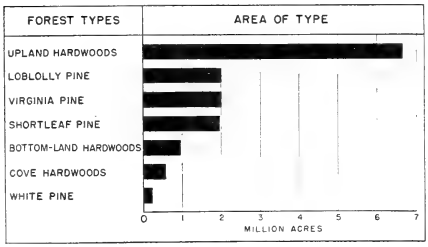

FIGURE 14.—*Area of forest types, 1940.*

Forest Types

Forest types were classified by the Forest Survey on the basis of species composition and the proportion of commercially important dominant trees.

The upland hardwood type occupies nearly one-half of the forest land of Virginia (fig. 14). It is the principal forest cover of the Mountain province, but it occurs also in the Piedmont and Coastal Plain (fig. 15). Of the total area in this type, 48 percent is in the mountains, 39 percent in the Piedmont, and only 13 percent in the Coastal Plain. This type is composed of a variety of species (table 3). The composition varies widely with the physiographic province, and within each province with soil type, elevation, and moisture conditions. In the Coastal Plain the principal species are white oak, southern red oak, black oak,

yellow-poplar, sweetgum, and beech, with some loblolly and other pines. In the Piedmont white oak is even more prevalent, comprising one-fourth of the total cubic-foot volume, followed by southern red oak, black oak, yellow-poplar, chestnut oak, and hickory. Pine is very limited. In the Mountain province, chestnut oak is the most prevalent species of this type, followed by scarlet, pin, and black oaks, post oak, northern red oak, hickory, and yellow-poplar. The pine component is very minor.

TABLE 3.—*Species composition of forest types expressed in percent of net cubic-foot volume, 1940*[1]

Species	Forest type							
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottom-land hardwood	Cove hardwood	Upland hardwood	All types
Softwoods:	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Pond pine	0.1				(2)			(2)
Loblolly pine	72.7	2.6	4.4		4.4		1.5	17.9
Shortleaf pine	3.5	62.6	7.9	3.0	.7	0.2	3.0	10.7
Virginia pine	1.6	6.0	56.3	1.8	.4	.5	1.6	7.8
White pine		.4	.7	31.8	(2)	.6	.6	1.0
Hemlock		(2)	(2)	21.8	(2)	1.6	.2	.6
Redcedar	.1	.9	.3	.2	.1	.1	.2	.3
White-cedar	(2)				1.2		(2)	.1
Cypress	.1				4.5		(2)	.5
Hardwoods:								
Red maple	.9	.7	.7	1.9	8.6	3.2	2.3	2.3
Blackgum	1.8	.6	.8	.8	19.9	1.5	2.6	3.7
Sweetgum	6.1	3.2	2.0	(2)	17.9	.1	3.6	5.3
Yellow-poplar	2.5	4.7	6.2	3.2	8.5	34.5	9.5	7.8
Northern red oak	.5	.9	.7	2.6	1.9	10.6	6.6	3.5
Other red oaks	3.6	6.5	7.3	7.7	4.2	2.9	16.8	9.5
White oak	3.5	4.8	6.3	8.0	3.4	4.3	19.8	10.3
Chestnut oak	(2)	1.5	.8	4.7	(2)	4.1	13.2	5.6
Other white oaks	.6	1.2	1.3	.4	.5	(2)	1.2	.9
Birch		(2)	(2)	1.4	(2)	2.8	.2	.2
Beech	.4	.1	.4		.8	.3	2.3	1.1
Hickory	.7	1.2	1.6	1.8	1.0	4.9	7.7	3.8
Cherry, walnut		(2)	(2)	.1	.1	1.3	.4	.2
Sugar maple		(2)	(2)	1.7	(2)	4.2	.4	.3
Ash	.1	.2	.2	.3	6.0	2.3	.6	1.0
Dogwood	.4	.4	.8	.1	.8	1.2	.9	.7
Black locust		.1	.1	.7	(2)	1.9	1.2	.6
Other hardwoods	.5	.9	.7	4.9	14.0	15.5	2.5	3.5
Scrub hardwoods	.3	.5	.5	1.1	1.1	1.4	1.1	.8
All species	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Based on net cubic volume of sound trees 5.0 inches d. b. h. and larger; tops and limbs of saw-timber-size hardwoods omitted.

[2] Less than 0.05 percent.

The loblolly pine type (fig. 16) ranks second in area, occupying 14 percent of the State's forest land, almost entirely in the Coastal Plain. The principal hardwood associates are sweetgum, southern red and black oaks, white oak, and yellow poplar. In terms of value, the loblolly pine type is the most valuable in the State, since it contains by far the largest saw-timber volume of any type, and its chief species is in wide demand for both lumber and pulpwood.

The Virginia pine type is almost equal in area to the loblolly pine type. Of the total type area, 69 percent is in the Piedmont, 17 percent is in the Coastal Plain, chiefly on the Northern Neck and Middle Peninsula, and the remainder is in the mountains. Principal associates in the Coastal Plain are loblolly pine, southern red and black oaks, white oak, yellow-poplar, and sweetgum. In the Piedmont, principal associates are shortleaf pine, yellow-poplar, "other red oaks," and white oak, although there are extensive areas of pure old-field stands (fig. 17). In the mountain unit, Virginia pine makes up 55 percent of the volume in the Virginia pine type, and shortleaf and white pines together, 11 percent. Black, southern red, post, and chestnut oaks are the common associated hardwoods.

The shortleaf pine type (fig. 18) is only slightly less extensive than the loblolly and Virginia pine types, and occurs on about 14 percent of the forest area. Of the total area of this type, 63 percent is in the Piedmont, 29 percent in the mountains, and only 8 percent in the Coastal Plain. In the Coastal Plain, shortleaf pine forms 53 percent of the volume in the type, and loblolly 17 percent. Principal hardwood associates are the "other red oaks," white oak, and sweetgum. In the Piedmont, shortleaf pine makes up 64 percent of the cubic-foot volume in the type, and loblolly and Virginia pines, 8 percent. "Other red oaks," yellow-poplar, white oak, and sweetgum are the prevalent hardwoods. From the standpoint of values, this is the most important type in the Piedmont. In the mountains, the shortleaf pine type—designated on the type map as the "shortleaf-pitch pine type"—occurs as narrow bands on the east slopes of the successive ridges of the province. In this type the volume of pitch pine exceeds that of shortleaf, and the two together form two-thirds of the total volume in the type. Scarlet, black, and pin oaks, chestnut oak, and white oak are the prevalent hardwood associates.

The bottom-land hardwoods type (fig. 19) is found on about 7 percent of the forest area. Of the total type area, 63 percent is in the Coastal Plain where it occurs in the Great Dismal Swamp and along the major rivers and their tributaries above tidewater. Here blackgum and tupelo (fig. 20) provide more than one-fourth of the total cubic-foot volume, and sweetgum nearly one-fifth. Red maple and yellow-poplar are other important hardwood species in this type. Cypress provides a little over 6 percent, and loblolly pine a little less than 6 percent, of total cubic-foot volume. This type is one of the most valuable in the Coastal province, containing the second largest saw-

FIGURE 15.—*Oaks are the principal species in the upland hardwood type, with yellow-poplar and hickory as common associates.*

FIGURE 17.—*Virginia pine commonly grows in pure stands, especially on old fields in the Piedmont.*

FIGURE 16.—*Loblolly pine makes up nearly three-fourths of the total cubic-foot volume of the loblolly pine type of the Coastal Plain.*

FIGURE 18.—*Shortleaf pine comprises three-fifths of the volume in the shortleaf pine type of the Piedmont.*

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FIGURE 19.—*Bottom-land hardwoods occupy nearly one million acres. This stand of yellow-poplar and gum is on the lower James River.*

F-441893

FIGURE 21.—*Yellow-poplar is the chief species in the cove hardwood type in the Blue Ridge.*

F-441767

FIGURE 20.—*Tupelos flourish in the swamps of the Coastal Plain, where they comprise one-fourth of the volume in the bottom-land hardwood type.*

F-441764

FIGURE 22.—*The white pine type occurs chiefly in the Blue Ridge and Shenondoah Mountains, but it is of relatively minor importance.*

timber volume per acre of the several types, and some of the most valuable species. In the Piedmont, it is confined to the river bottoms and, in general, is not important.

The cove hardwood type (fig. 21) is distinctly a mountain type, although 27 percent of the total type area is reported by the Forest Survey as in the Piedmont, owing to the inclusion in the Piedmont survey unit of the whole east slope of the Blue Ridge Mountains. Yellow-poplar is the most prevalent species, making up over one-half the volume in this type in the Piedmont and nearly one-fourth of the volume in the mountains. Principal associates are northern red, scarlet, black, and white oaks, sugar maple, and basswood. The cove hardwood is the most valuable mountain type, having the second highest saw-timber volume per acre and the highest-priced species. As its name implies, it is confined to the north- and west-facing coves of the mountains and to the lower slopes, on deep, moist soils.

The white pine type (fig. 22) is also confined to the mountains. White pine and hemlock make up over half the total type volume. White, scarlet, black, and northern red oaks, basswood, and yellow-poplar are the principal hardwood associates. This type also includes the very limited amount of red spruce found in the State. The white pine type occurs chiefly on the west slope of the Blue Ridge in southern Virginia and in the Shenandoah Mountains in the west-central part of the State, but smaller areas are well scattered throughout the whole Mountain province.

The type map at the back of this report delineates the broad areas of the State within which the indicated forest type predominates. No attempt has been made to delineate minor types or to show agricultural land.

Forest Condition

Forest condition[6] is classified, on the basis of the size of dominant trees, stocking, stand volume, and cutting history, into three classes: Saw timber, cordwood, and reproduction stands. Saw timber may be either old growth or second growth.

In the Coastal Plain the area in saw timber was nearly twice that in cordwood (table 4, fig. 23), in the Piedmont the proportion was nearly equal, while in the mountains there was considerably more cordwood than saw-timber acreage. Nearly three-fifths of all the reproduction stands were in the Piedmont.

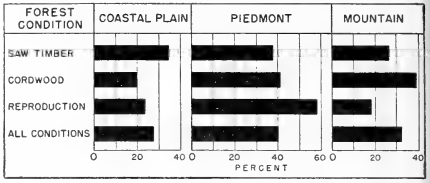

FIGURE 23.—*Distribution of forest area by forest condition and physiographic province, 1940.*

In the State as a whole, nearly one-half the forest area was in the saw-timber condition. Almost as large an area was in cordwood stands, while the remaining 5 percent was classed as reproduction. Only 18,600 acres was classified as not restocking (fig. 24), and this area is included hereafter with reproduction.

Of the State's saw-timber area of 7,155,000 acres, 45 percent was in softwood types, 55 percent in hardwood types. Broken down by individual forest types, 42 percent was upland hardwoods, 19 percent was loblolly pine, 14 percent was shortleaf pine, and the remaining one-fourth mainly Virginia pine and bottom-land hardwoods (table 25, Appendix). That so large an area of forest land could still be classed as saw timber is in some respect reassuring, but it must be remembered that the minimum volume-per-acre requirements for saw timber are low. Assuming minimum diameters and heights, only 15 to 20 trees per acre are needed to classify a stand as operable saw timber.

Of the 6,553,000 acres in the cordwood condition, only 39 percent was in softwood types, 61 percent in

[6] For definitions of condition classes and tree-size classes, see Appendix, p. 57.

TABLE 4.—*Distribution of forest area by physiographic province and forest condition, 1940*

Physiographic province	Saw timber		Cordwood		Reproduction		All conditions	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Coastal Plain	2,477,100	63.2	1,276,300	32.6	165,800	4.2	3,919,200	100.0
Piedmont	2,710,700	46.5	2,708,000	46.5	409,200	7.0	5,827,900	100.0
Mountain	1,967,000	42.2	2,569,000	55.1	128,900	2.7	4,664,900	100.0
Total	7,154,800	49.6	6,553,300	45.5	[1] 703,900	4.9	14,412,000	100.0

[1] Includes 18,600 acres (0.1 percent of total forest area) in nonrestocking condition.

F-441809

FIGURE 24.—*This clear-cut pine-hardwood stand is slowly restocking, but to inferior species.*

F-441

FIGURE 26.—*Shortleaf pine cordwood stands occur on nearly 900,000 acres, chiefly in the Piedmont.*

F-441777

FIGURE 25.—*Upland hardwoods of cordwood size occupy 3.4 million acres in Virginia.*

F-441765

FIGURE 27.—*Loblolly pine is restocking cut-over land along the lower James River in the Coastal Plain.*

hardwood. By individual types, 3.4 million acres was upland hardwoods (fig. 25), 1 million acres was Virginia pine, 870,000 acres was shortleaf pine (fig. 26), 580,000 acres was loblolly pine (fig. 27), and the balance was in three less extensive types. In the upland hardwood type, the cordwood area exceeded the saw-timber area by nearly one-half million acres. Virginia pine was the only other type in which the cordwood area exceeded the saw-timber area, in this case by 323,000 acres. One reason for this is the naturally short life and small size of the species. Another is the intense demand for pine saw timber in the Piedmont, where Virginia pine is most abundant.

Only 5 percent of the forest area, or 704,000 acres, was classed as reproduction. Such a small area speaks well for the recuperative powers of the forests of Virginia.

In interpreting these data on acreage of forest conditions, a word of caution is in order. It can be said with certainty that there is a vast acreage of land in Virginia now producing or capable of producing timber, and that there is very little of the area which does not have a nucleus of growing stock sufficient to yield a satisfactory volume of wood if given adequate protection and time to grow. It is also true, on the other hand, that much land supports inferior species, that most areas have only one-third to one-half full stocking, and that not all the saw-timber area is commercially operable because of small volumes per acre in poor-quality trees.

Age of Stands

Old-field stands are generally even-aged. Forest-grown stands commonly contain several age classes, except where the stand has come in after heavy cutting. The old-growth stands in the pine types are more than 100 years old, whereas second-growth saw timber is 40 to 45 years old, and cordwood stands are chiefly 20 to 30 years. These ages are the average for all sites; on good sites, pine will attain sawlog size at an earlier age.

Hardwood forests usually contain a mixture of reproduction, saplings, and sawlog-size trees, the proportion of each varying with the forest condition. Old-field sweetgum or yellow-poplar stands, however, are commonly even-aged. Other even-aged hardwood stands are occasionally found as a result of prompt restocking after heavy cutting, or more rarely as old-growth timber without an understory of younger trees. Old-growth hardwood stands exceed 100 years of age, some individual trees being several hundred years old. Second-growth saw timber averages 50 to 70 years old, and cordwood stands are 25 to 30 years of age.

To produce an annual sustained yield of wood, a forest should consist of a series of timbered areas approximately equal in potential productivity, and varying in age by roughly even intervals from the youngest to the oldest age class. The proportionate area required in each age class will vary with the length of rotation which, in turn, will vary with financial considerations, products being grown, site quality, and other factors. In general, pine sawlogs can be grown in Virginia in 25 to 40 years, depending on the site, but it takes 60 years or more to grow high-quality saw timber. With hardwood saw timber, the minimum rotation is about 60 years, but 80 to 100 years is usually needed to obtain high-quality timber. Yellow-poplar and sweetgum will produce small saw timber in 50 to 60 years.

The distribution of age classes in the hardwood types favors continuous production of saw timber (fig. 28) because it approaches the ideal forest just described. The bottom-land hardwoods type has the best distribution. The loblolly and shortleaf pine stands have about the right area in stands less than 25 years old, somewhat too much in the 26- to 55-year age group, and a shortage in the two oldest age groups, if an ample supply of high-quality saw timber is the objective. Virginia pine is a short-lived species, not too desirable for lumber, and its age-class distribution favors continuous yields of pulpwood.

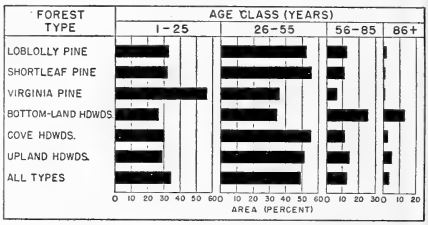

FIGURE 28.—*Proportionate distribution of area of each forest type by age class.*

Site Quality

It is a common but false belief that any land too poor for agricultural crops or improved pasture will, if devoted to "forestry," grow successive crops of good timber. Actually some land is too poor to do even that; it may grow trees, but not commercial timber. Such land has been classed herein as "noncommercial." Other land, in the commercial class, may grow

only limited quantities of timber of low quality because forest soils, like all others, vary in productive capacity. The combined effect of soil, climate, slope, exposure, and other factors is measured by site quality.

The site quality of forest land was measured in two ways; for the pine lands of the Coastal Plain and Piedmont it was based on the height of average dominant pine trees at 50 years of age (site index); for all hardwoods in the State and pines in the mountains it was based on merchantable height, tree form, and soil and moisture conditions. Pine sites were considered good if the site index was 80 feet or above, fair if 60 to 79 feet, and poor if less than 60 feet. Hardwood sites were considered good if the merchantable trees, exclusive of yellow-poplar, averaged three or more 16-foot logs, fair if they averaged 1.5 to 3 logs, and poor if they averaged less than 1.5 logs. Longer merchantable lengths were required in yellow-poplar, pine, spruce, and hemlock in the mountains.

In the Coastal Plain 22 percent of the forest land was rated as of good site and 68 percent as of fair site, a total of 90 percent that was of satisfactory productivity (table 5). This is a much higher proportion than in the rest of the State. The deep soils, abundant moisture, and lack of erosion in the Coastal Plain account for the better growing conditions. In the Piedmont, on the other hand, only 8 percent of forest area was of good site, and 69 percent was of fair, a total of 77 percent of satisfactory productivity. Rapid and severe deterioration of soil following land abuse is the major cause of lower site values in the latter province.

TABLE 5.—*Distribution of forest area by physiographic province and site class, 1940*

Physiographic province	Good	Fair	Poor
	Percent	*Percent*	*Percent*
Coastal Plain	22	68	10
Piedmont	8	69	23
Mountain	3	74	23
All provinces	10	71	19

In the mountains only 3 percent of the area was of good site, but 74 percent was of fair. Good sites are rare because of the effects of topography and thin soils. In general they are confined to the lower north slopes, coves, and narrow valley floors. Except for the upper coves, these locations are commonly put in cultivation or grass pasture, reducing still further the forest area in the good-site class.

Stocking

The relation of the density of the average stand in terms of volume in cords per acre to the density of the best 10 percent of stands is referred to, in this report, as stocking density. Data are available only for the Coastal Plain and Piedmont. In the former, the average pine stand was only half stocked (fig. 29), containing 18 cords per acre as contrasted with 36 cords for the best 10 percent of the stands. Degree of stocking varied only slightly from age class to age class, ranging from 41 percent in the 11- to 20-year age class to 55 percent in the 51- to 60- and 61- to 70-year classes, then declining in the older age classes.

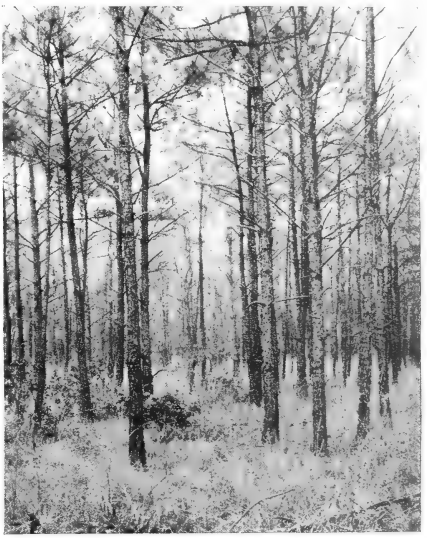

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FIGURE 29.—*This loblolly pine stand is about 60 percent stocked, or 10 percent better than the average pine stand in the Coastal Plain.*

In the northern Piedmont, average stocking in the upland hardwood type was only 49 percent, while in the shortleaf pine-hardwood type of the southern Piedmont it was 61 percent. For the Piedmont as a whole in all cordwood and saw-timber stands, pine types averaged 47 percent stocking, hardwood types 51 percent.

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The Volume of Timber

THE estimates of standing timber in the State refer to the volume in all trees 5 inches d. b. h. and larger, including dead chestnut, and are expressed in three units of measure: board feet, cords, and cubic feet.[7]

Saw-Timber Volume

In 1940, Virginia's forests contained 25 billion board feet of saw timber, when scaled by the International ¼-inch log rule. In this report, the volumes obtained by this rule are considered the equivalent of actual yield of unseasoned lumber under prevailing sawmill practice. In 1945, Virginia ranked ninth among the 12 States of the South in total board-foot volume of timber, with 7 percent of the total volume of saw timber in this region. Forty-seven percent of the State's saw timber as of 1940 was in the Coastal Plain, 30 percent in the Piedmont, and 23 percent in the mountains.

[7] Definitions of the three kinds of volume, and of other terms, are given in the Appendix, p. 58.

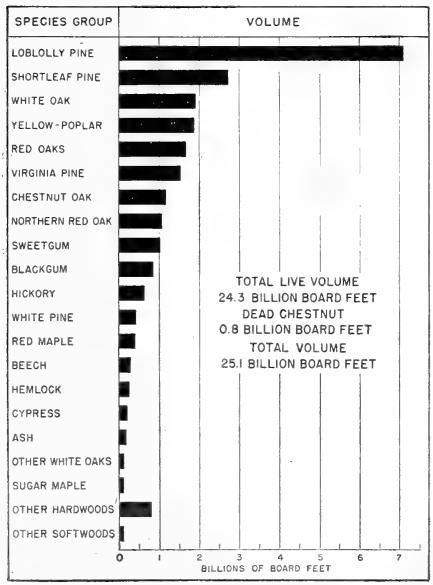

FIGURE 30.—*The volume of saw timber by species, 1940.*

Volume by Species

The total board-foot volume of live timber was almost exactly half softwood and half hardwood, the softwood volume exceeding the hardwood by only 242 million board feet (table 6). Loblolly pine alone, however, made up 29 percent of the volume, with its more than 7 billion board feet (fig. 30). It was followed in importance by shortleaf pine, white oak, yellow-poplar, "other red oaks" (black, pin, scarlet, and southern red oaks), Virginia pine, and chestnut oak. The remaining 26 percent was made up by other species, each providing less than 5 percent of total volume, although all the "gums" (sweetgum, black and water tupelos) together made up nearly 8 percent. There were 758 million board feet of dead chestnut still standing and usable in 1940; a considerable volume has since been cut in filling the increased demands for extract wood occasioned by war needs.

Most of the loblolly pine, sweetgum, and blackgum saw timber is in the Coastal Plain, a large part of the shortleaf and Virginia pines and yellow-poplar is in the Piedmont, and all of the dead chestnut is in the mountains. Table 26 gives details on the volume by species and forest condition.

TABLE 6.—*Net saw-timber volume (International ¼-inch rule) by species and forest condition, 1940*

Species	Forest condition		Total	
	Saw timber	Cordwood [1]		
Softwoods:	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*Percent*
Loblolly pine [2]	6,913,500	145,900	7,059,400	29.0
Shortleaf pine	2,492,800	220,700	2,713,500	11.2
Virginia pine	1,404,500	137,000	1,541,500	6.3
White pine	383,900	30,000	413,900	1.7
Hemlock [3]	240,100	11,600	251,700	1.0
Redcedar	31,500	9,700	41,200	.2
White-cedar	64,000	900	64,900	.3
Cypress	201,100	800	201,900	.8
Total	11,731,400	556,600	12,288,000	50.5

TABLE 6.—*Net saw-timber value, etc.*—Continued

Species	Forest condition		Total	
	Saw timber	Cordwood [1]		
Hardwoods:	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*Percent*
Red maple	373,000	19,800	392,800	1.6
Blackgum	823,400	24,200	847,600	3.5
Sweetgum	989,500	31,700	1,021,200	4.2
Yellow-poplar	1,810,000	69,900	1,879,900	7.7
Northern red oak	1,030,400	33,700	1,064,100	4.4
Other red oaks	1,581,800	93,000	1,674,800	6.9
White oak	1,827,600	75,000	1,902,600	7.8
Chestnut oak	1,109,500	64,100	1,173,600	4.8
Other white oaks	101,200	6,800	108,000	.4
Birch	34,500	2,800	37,300	.2
Beech	276,900	8,800	285,700	1.2
Hickory	598,800	37,100	635,900	2.6
Cherry, walnut	42,400	7,800	50,200	.2
Sugar maple	92,400	4,100	96,500	.4
Ash	171,300	4,900	176,200	.7
Other hardwoods [4]	670,600	29,200	699,800	2.9
Total	11,533,300	512,900	12,046,200	49.5
All live species	23,264,700	1,069,500	24,334,200	100.0
Dead chestnut	444,400	314,000	758,400	
All species	23,709,100	1,383,500	25,092,600	

[1] Includes the saw-timber volume, 5,100 M board feet, in the reproduction areas.
[2] Includes pond pine, 3,500 M board feet.
[3] Includes red spruce, 2,700 M board feet.
[4] Includes basswood, sycamore, bay, magnolia, willow, and other minor species.

Volume by Diameter Classes

A better picture of the current availability of the saw-timber volume for conversion to sawlogs is provided by an analysis of volume distribution by diameter classes. The 25 billion board feet cannot all be counted as a current source of quality lumber because in 1940 nearly one-fourth of it was in trees less than 13 inches d. b. h. These small trees are suitable for pulpwood or generally low-grade lumber. One-half of the total volume was in trees from 13.0 to 18.9 inches in diameter, while only one-fourth was in trees now 19 inches or more in diameter, which usually yield the most high-grade lumber (table 7). Nearly half of the softwood volume was in the 10- to 12-inch class, and only one-eighth of it in the 20-inches-and-over class. The hardwood volume was distributed more evenly (minimum saw-timber diameter for hardwoods is 13.0 inches), 57 percent in the 14- to 18-inch class, 43 percent in the 20-inches-and-over class.

Three of the hardwood species and one softwood had a larger percent of volume in the 20-inches-and-over class than in the 14- to 18-inch class. These were northern red oak, chestnut oak, sugar maple, and hemlock. All are predominantly mountain species, and the reason for this uncommon volume distribution is in part their location in more inaccessible logging chances. Also, hemlock was not in great demand for lumber until World War II. Chestnut oak is a ridge-top and upper-slope type, but the species is not in high demand for lumber, and has a relatively low stumpage value and high logging cost. The hardwood species with the lowest percentage of volume in the largest diameter class were ash and sweetgum, other white oaks, and hickory. These are predominantly Coastal Plain and lower Piedmont species, and in general are heavily cut.

TABLE 7.—*Distributors of the saw-timber volume, by species group and tree-diameter class, 1940*

Species group	10–12 inches	14–18 inches	20+ inches
Softwoods:	*Percent*	*Percent*	*Percent*
Loblolly pine	40.5	45.6	13.9
Shortleaf pine	60.6	33.1	6.3
Virginia pine	71.0	27.8	1.2
White pine	28.5	39.1	32.4
Hemlock	14.0	32.2	53.8
Redcedar	78.2	19.9	1.9
White-cedar	10.9	45.5	43.6
Cypress	27.7	43.7	28.6
All softwoods	47.6	40.0	12.4
Hardwoods:			
Red maple		65.1	34.9
Blackgum		59.5	40.5
Sweetgum		71.3	28.7
Yellow-poplar		61.2	38.8
Northern red oak		39.3	60.7
Other red oaks		60.2	39.8
White oak		50.9	49.1
Chestnut oak		49.1	50.9
Other white oaks		68.5	31.5
Birch		61.1	38.9
Beech		56.7	43.3
Hickory		66.8	33.2
Cherry, walnut		62.2	37.8
Sugar maple		40.6	59.4
Ash		71.4	28.6
Other hardwoods		59.9	40.1
All hardwoods		57.4	42.6
All live species	24.0	48.6	27.4
Dead chestnut		49.7	50.3
All species	23.3	48.6	28.1

There was considerable variation among the three physiographic provinces in board-foot-volume distribution by diameter classes. The Piedmont particularly was noticeable for the large softwood volume in the lowest diameter class, while the mountains had both the lowest proportion in the 10- to 12-inch class and the highest proportion in the largest size. In the Coastal Plain, 42 percent of the softwood volume was in the 10- to 12-inch class, 44 percent in the 14-

to 18-inch class, and 14 percent in the 20-inch-plus class (fig. 31, table 27).

In respect to hardwood board-foot volume, the distribution in the Coastal Plain and Piedmont was almost identical—about 60 percent in the 14- to 18-inch class and 40 percent in the 20-inch-plus class. The mountains had only 52 percent of hardwood volume in the 14- to 18-inch class, and 48 percent in the larger class.

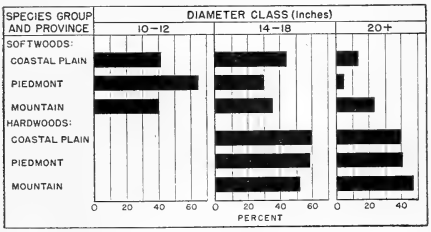

FIGURE 31.—*Distribution of board-foot volume by diameter class and province, 1940.*

In interpreting these data, it must be recognized that the volume in the trees 13 inches and larger in diameter is not all immediately available for productive sawmilling or other conversion. Some of this volume is in scattered trees in younger stands, some of it is in "wolf" trees—large, limby trees often left in previous cuttings—some of it is in areas of poor accessibility where only high lumber prices can insure a profitable operation because of high logging costs, and some of it is in species which are not in general demand. On the other hand, the larger portion of this volume is operable. Some further light on degree of operability is given by the volume per acre in the various types of forest in the State.

Volume Per Acre

While other factors such as size, quality, location, and other items must be recognized in judging the operability of a logging chance, it is the volume per acre which weighs heaviest. There must be enough saw timber per acre to support the operation. The minimum varies, of course, with the type of operation, the kind and quality of the timber, and the terrain. In the days of railroad logging to a stationary mill, heavy stands on large areas were required to offset the high costs invested in railroads and logging equipment. Except for a few areas, Virginia's forests will no longer support this type of operation. Truck logging to a small stationary mill (small in comparison with the "big" mills of railroad logging history) can be supported by a stand of 1,500 to 2,000 feet per acre, or less, of course, for specialty woods bringing high prices, or where all other factors are especially favorable. Portable mills which go to the timber, instead of having it brought to them, operate on as small a volume as 300 to 500 board feet per acre, though with the lower limit the operation may be marginal financially.

Almost one-half (3.4 million acres) of the saw-timber area in 1940 bore stands averaging less than 2,000 board feet per acre. In the softwood types, 40 percent, and in the hardwood types, 52 percent of the area was in this low stocking class (table 28, fig. 32). This poorly stocked land bore 17 percent of the total board-foot volume in saw-timber stands, or an average of only 1,178 board feet per acre. This means that on nearly one-half of Virginia's saw-timber area the forest was best adapted to operation by small portable mills. This partially explains the predominance of the small mill in Virginia's lumber industry.

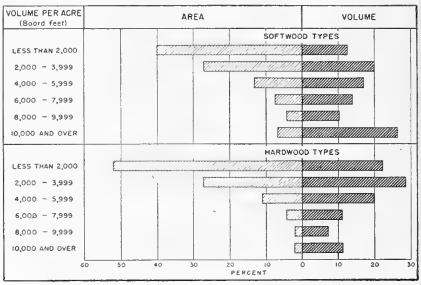

FIGURE 32.—*Distribution of saw-timber area and board-foot volume by volume-per-acre classes and type groups, 1940.*

An additional 40 percent of the saw-timber area bore stands of 2,000 to 6,000 board feet per acre, which contained 42 percent of the total volume on saw-timber areas. These areas are suitable for larger stationary mills supported by truck logging, but even in these it is usually cheaper to take the mill to the woods and haul lumber rather than logs. On only 314,000 acres (4.4 percent of area) did the stands average 10,000 or more board feet per acre, but these areas had 19 percent of the total volume, averaging 14,300 board feet per acre. Most of it was in limited areas of the coastal bottom-land hardwoods, in a few large holdings in the loblolly pine type, and in the less accessible deep coves of the mountains. Softwood stands in this class averaged better than 14,600 feet per acre, and hardwood stands 13,500 feet.

The Mountain province had 60 percent of its saw-timber area in the "less than 2,000" board-feet-per-acre class, followed by the Piedmont with 51 percent. The Coastal Plain had only 32 percent in the lowest class (table 28). The mountains and Piedmont likewise had less than 2 percent of the area in the "10,000 and over" class, whereas the Coastal Plain had 10 percent. This resulted in the Coastal Plain having 32 percent of its volume in the 10,000-feet-or-more-per-acre class, whereas the Piedmont and mountains had only 8 and 6 percent, respectively.

In the Coastal Plain no county had less than 1,000 board feet per average forest acre in 1940, and only 3 counties had less than 2,000 feet. One county (Northampton) averaged better than 6,000 feet per acre, and 7 others (Accomac, Isle of Wight, James City, Mathews, Southampton, Warwick, York) averaged 4,000–6,000 feet. The other 23 Coastal Plain counties averaged 2,000–4,000 feet per acre. In the Piedmont no county had over 2,100 feet per acre, and in only 2 (Loudoun and Mecklenburg) the average exceeded 2,000 feet. Eight counties had less than 1,000 board feet per acre. In the Mountain province, no county averaged as much as 2,000 feet, while 16 counties averaged less than 1,000 feet per acre.

The heaviest saw-timber stands were in the loblolly pine type, followed by the bottom-land and hardwood type, and the white pine type (table 8). Lowest volumes per acre were in the upland hardwood and shortleaf pine types. The average saw-timber stand had 3,250 feet per acre.

In North Carolina (*3*) saw-timber stands averaged 4,280 feet per acre, or more than 1,000 board feet per acre higher than in Virginia. In South Carolina (*4*) the average stand per acre on all forest land was 2,600 board feet for the pine types and 3,500 feet for the hardwood types, contrasted with 2,100 and 1,500, respectively, in Virginia. These and preceding facts indicate how severely Virginia has cut into her capital of forest resources. The general understocking of all forest types in all parts of the State is one of the most disturbing aspects of the forest situation. While understocking is common to all Southern States, it has reached rather alarming proportions in Virginia, where nearly half of the saw-timber area bears stands averaging less than 1,200 board feet per acre.

TABLE 8.—*Board-foot volume (International ¼-inch rule) per average acre in saw-timber stands by types, 1940*

Species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottom-land hardwood	Cove hardwood	Upland hardwood	
	Bd. ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
Loblolly and shortleaf pine	4,830	1,890	460	110	420	10	160	1,310
Virginia pine	60	150	1,430	50	20	10	40	200
Other softwoods	10	30	30	2,610	430	110	40	130
Oaks	190	220	380	610	420	900	1,420	790
Gums and yellow-poplar	310	190	240	110	1,980	1,120	420	510
Other hardwoods	70	40	70	290	1,050	970	360	310
All live species	5,470	2,520	2,610	3,780	4,320	3,120	2,440	3,250
Dead chestnut	-----	10	(1)	120	-----	210	120	60

[1] Less than 5.

Volume in Cords

The total volume of sound wood and bark measured in cords, including all trees 5.0 inches d. b. h. and larger, was more than three times the volume in saw-logs alone—a total of 204.5 million cords (table 9). The 66.8 million cords of sawlog material includes the saw-timber volume previously discussed. The volume in upper stems of sawlog-size trees includes the large limbs of hardwoods to a minimum diameter of 4.0 inches inside bark. That in cull trees is the sound material in the stems of cull softwoods and in the stems and limbs of cull hardwoods. The volume in under-sawlog-size trees is that in softwoods from 5.0 to 8.9 inches d. b. h. and in hardwoods from 5.0 to 12.9 inches d. b. h.

TABLE 9.—*Volume of timber in cords by species and class of material, 1940* [1]

Species	Saw-timber trees		Under-sawlog-size trees	Cull trees	All material
	Sawlogs	Upper stems			
Softwoods:	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*
Loblolly pine	17,317.1	3,657.0	7,322.8	650.0	28,946.9
Shortleaf pine	7,772.9	2,208.8	7,439.1	691.0	18,111.8
Virginia pine	3,970.4	1,307.5	6,069.3	1,388.4	12,735.6
White pine	919.1	207.2	304.9	133.4	1,564.6
Hemlock	570.1	109.4	105.8	87.9	873.2
Redcedar	101.2	-----	262.2	4.4	367.8
White-cedar	151.0	13.7	5.4	-----	170.1
Cypress	481.0	146.7	100.2	84.8	812.7
Total	31,282.8	7,650.3	21,609.7	3,039.9	63,582.7
Hardwoods:					
Red maple	1,076.0	624.6	2,139.6	2,671.9	6,512.1
Blackgum	2,424.2	1,284.8	2,693.0	2,483.7	8,885.7
Sweetgum	2,470.3	1,474.6	5,066.4	1,163.0	10,174.3
Yellow-poplar	4,933.5	2,679.5	6,145.7	1,279.0	15,037.7
Northern red oak	2,658.7	1,575.8	1,825.9	1,216.4	7,276.8
Other red oaks	4,799.4	2,605.1	9,187.2	2,494.8	19,086.5
White oak	5,203.9	2,925.1	9,575.9	2,428.2	20,133.1
Chestnut oak	3,547.1	1,897.4	4,812.0	5,180.8	15,437.3

[1] Volumes shown represent State average for year. In Coastal Plain and southern Piedmont they are as of Jan. 1; in northern Piedmont and mountains they are as of Dec. 31.

TABLE 9.—*Volume of timber in cords by species and class of material, 1940*—Continued

Species	Saw-timber trees		Under-sawlog-size trees	Cull trees	All material
	Sawlogs	Upper stems			
Hardwoods—Continued	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*
Other white oaks	337.3	174.4	1,232.9	447.9	2,192.5
Birch	100.6	59.5	218.6	291.1	669.8
Beech	761.7	461.8	614.2	565.3	2,403.0
Hickory	1,962.6	1,069.4	3,687.7	981.2	7,700.9
Cherry, walnut	129.5	66.2	177.0	83.1	455.8
Sugar maple	259.2	158.5	159.5	315.2	892.4
Ash	461.2	247.6	1,065.0	633.0	2,406.8
Dogwood			1,160.0	288.6	1,448.6
Black locust			1,096.0	185.0	1,281.0
Other merchantable hardwoods	1,873.6	1,059.2	2,701.4	2,330.4	7,964.6
Scrub hardwoods				1,355.8	1,355.8
Total	32,998.8	18,363.5	53,558.0	26,394.4	131,314.7
All live species	64,281.6	26,013.8	75,167.7	29,434.3	194,897.4
Dead chestnut	2,552.5	1,083.0	2,891.0	3,086.3	9,612.8
All species	66,834.1	27,096.8	78,058.7	32,520.6	204,510.2

Volume of Class of Material

More than two-thirds of the total live volume in cords was in hardwoods (table 9), a total of 131.3 million cords out of 194.9 million cords. An additional 9.6 million cords was in dead chestnut. The sawlog equivalent of the board-foot volume (66.8 million cords) comprised one-third of the total volume, and upper stems of these same trees contributed another 13 percent. Under-sawlog-size trees made up 38 percent, and sound wood in cull trees the remaining 16 percent. Of the live volume in cull trees, 90 percent was in hardwoods—an indication of the damage to hardwoods caused by fire, ice, and other factors, and of the effect of poor site on tree form. Softwoods and hardwoods contributed about equal proportions of the sawlog volume, but in under-sawlog trees there was about 2.5 times as much volume in hardwoods as in softwoods. This apparent excess is due in part to the higher diameter limit set for under-sawlog-size hardwoods, 12.9 inches d. b. h. in contrast to 8.9 for softwoods. However, a comparison of the cord volume in all sound trees up to 12.9 inches d. b. h. showed that the hardwood volume exceeded the softwood by nearly 25 percent.

That so large a proportion of the cord volume, especially in the smaller trees, was in hardwoods is cause for thought. These young trees are the forest of tomorrow. Even in the Coastal Plain, which is forested largely with pine, 64 percent of the volume in under-sawlog-size trees was in hardwood species in 1940 (fig. 33), while in the Piedmont, the hardwood volume in this class was 69 percent of the total (table 29). In the mountains, of course, it was almost entirely hardwood.

Two courses of action, neither mutually exclusive, appear to face pine-timber operators in Virginia. One is to adopt at once conscious steps of forest management to favor pine in the succession on their own lands; as a supplement to this, operators will need to undertake the difficult and not always feasible task of favoring similar succession on the lands of others from whom they get their timber. The second course is for operators to recognize that their product in the next or succeeding rotations will be cut increasingly from hardwood species and to adapt their operations to the use of more hardwood. Both courses—increase of softwood supplies and utilization of hardwoods—will presumably be followed, depending on circumstances in individual cases. Needless to say, there will still be a lot of softwoods produced in Virginia in future years, but the present ratio between the two species groups will probably be materially altered.

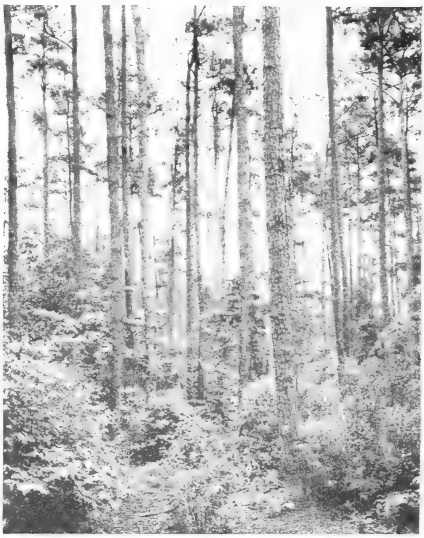

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FIGURE 33.—*Hardwoods predominate in the understory, even in the pine forests of the Coastal Plain, and compete strongly with pine seedlings for space and nutrients.*

In the case of the volume in upper stems (and in limbs of hardwoods), there was also a heavy predominance of hardwoods. Hardwood tops and limbs are rarely utilized, whereas pine tops can be readily used for pulp and fuel wood and a longer portion of the main stem is used for lumber. Utilization of hardwood tops and limbs is one of the yet unsolved problems in decreasing woods waste, but recent pulping and chemical developments may open the way to utilize profitably a much larger portion of this material than at present. A somewhat similar problem is raised by the sound-wood volume in cull hardwoods. As noted previously, 90 percent, 26 million cords, of the total live volume in cull trees was hardwood. The bulk of the hardwood volume in culls, moreover, was in the oaks, hickories, and scrub hardwoods, which have been little used for pulpwood. Here is a major problem in utilization and stand improvement, the solution of which is difficult to envisage. Greater use of sound wood in cull hardwoods for fuel wood, tobacco wood, mine props, pulpwood, and any other use for which a market is available is silviculturally desirable.

Comparison of the cord volumes by diameter classes for the four most abundant species reveals the great predominance of volume in small trees (fig. 34, table 10). Only 38 percent of the volume in loblolly pine, 18 percent of that in shortleaf pine, 35 percent of the white oak volume, and 45 percent of that in yellow-poplar was in trees more than 13 inches d. b. h. These four species were not particularly selected to illustrate a bad situation. For all species, the distribution showed only 34 percent of the volume to be in trees more than 13 inches d. b. h. If this distribution of volume remains substantially unchanged in the future, high-quality lumber cannot be produced in anything like the amount which has flowed from Virginia's forests in the past. Continued overcutting of large trees and the practice of "high-grading" will further

TABLE 10.—*Net volume in cords by species and diameter class, 1940* [1]

Species	Diameter class				Total	
	6–8 inches	10–12 inches	14–18 inches	20+ inches		
	M cords	*M cords*	*M cords*	*M cords*	*M cords*	*Percent*
Softwoods:						
Loblolly pine	7,322.8	10,193.4	8,558.4	2,222.3	28,296.9	19.3
Shortleaf pine	7,439.1	6,908.3	2,654.1	419.3	17,420.8	11.9
Virginia pine	6,069.3	4,018.5	1,214.4	45.0	11,347.2	7.7
White pine	304.9	392.6	428.5	305.2	1,431.2	1.0
Hemlock	105.8	134.8	224.8	319.9	785.3	.5
Redcedar	262.2	80.5	18.9	1.8	363.4	.2
White-cedar	5.4	22.2	77.0	65.5	170.1	.1
Cypress	100.2	155.3	207.3	118.4	581.2	.4
Total	21,609.7	21,905.6	13,383.4	3,497.4	60,396.1	41.1
Hardwoods:						
Red maple	1,065.8	1,073.8	727.2	348.8	3,215.6	2.2
Blackgum	1,043.2	1,649.8	1,529.2	895.0	5,117.2	3.5
Sweetgum	2,310.0	2,756.4	1,817.7	652.6	7,536.7	5.1
Yellow-poplar	2,795.3	3,350.4	3,167.2	1,766.3	11,079.2	7.5
Northern red oak	754.1	1,071.8	1,165.0	1,493.7	4,484.6	3.1
Other red oaks	4,252.6	4,934.6	3,078.0	1,721.4	13,986.6	9.5
White oak	4,201.5	5,374.4	2,860.5	2,343.4	14,779.8	10.1
Chestnut oak	2,142.7	2,669.3	1,845.7	1,701.4	8,359.1	5.7
Other white oaks	541.0	691.9	244.2	93.1	1,570.2	1.1
Birch	95.5	123.1	65.9	34.7	319.2	.2
Beech	223.0	391.2	460.2	301.5	1,375.9	.9
Hickory	1,570.1	2,117.6	1,389.1	573.5	5,650.3	3.8
Cherry, walnut	72.0	105.0	84.8	44.7	306.5	.2
Sugar maple	80.6	78.9	112.2	147.0	418.7	.3
Ash	545.1	519.9	341.3	119.9	1,526.2	1.0
Dogwood	723.7	329.2	99.0	8.1	1,160.0	.8
Black locust	515.5	366.5	166.7	47.3	1,096.0	.8
Other merchantable hardwoods	1,159.6	1,541.8	1,190.5	683.1	4,575.0	3.1
Total	24,091.3	29,145.6	20,344.4	12,975.5	86,556.8	58.9
All live species	45,701.0	51,051.2	33,727.8	16,472.9	146,952.9	100.0
Dead chestnut	1,043.7	1,847.3	2,496.1	3,142.7	8,529.8	
All species	46,744.7	52,898.5	36,223.9	19,615.6	155,482.7	

[1] This table differs from table 9 in that the volume contained in cull trees and upper stems and limbs of hardwood and cypress saw timber is not included. As in table 9, however, volume is State average for year. See footnote to table 9.

aggravate this undesirable balance in the growing stock, and reduce future production of high-quality products.

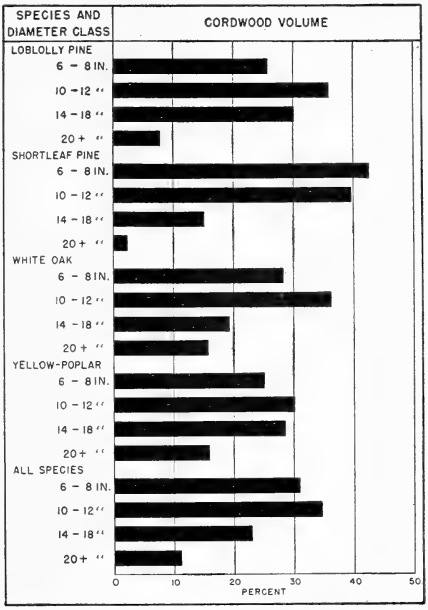

FIGURE 34.—*Distribution of net cord volume by diameter class, four important species, and all species.*

Volume Per Acre

Average volume per acre by forest types ranged from a low of 7.8 cords in the Virginia pine type to a high of 17.1 in the loblolly pine type (table 11). The strictly hardwood types ran from 8.2 cords in the upland hardwoods to 14.5 cords in the bottom-land hardwoods. All forest land averaged 10.2 cords, not including a little over one-half cord per acre of dead chestnut. As would be expected, the Mountain province had the lowest average volume per acre (6.3 cords), the Coastal Plain the highest (15.3 cords), while the Piedmont averaged 9.9 cords.

TABLE 11.—*Net volume per acre in cords by forest condition and type, 1940* [1]

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
Saw timber:	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*
Loblolly and shortleaf pines	18.34	10.68	2.31	0.43	1.23	0.04	0.59	5.51
Virginia pine	.37	.81	8.24	.26	.07	.05	.20	1.11
Other softwoods	.03	.15	.15	8.15	1.20	.38	.13	.40
Oaks	1.86	2.17	2.70	3.33	2.01	3.23	7.13	4.31
Gums and yellow-poplar	2.33	1.28	1.49	.60	9.79	5.22	2.18	2.76
Other hardwoods	.65	.53	.74	1.76	6.23	5.39	2.45	2.11
All live species	23.58	15.62	15.63	14.53	20.53	14.31	12.68	16.20
Dead chestnut	-----	.15	.07	1.15	.04	1.73	1.32	.69
Cordwood and reproduction:								
Loblolly and shortleaf pines	3.35	2.57	.37	.26	.20	.02	.26	.87
Virginia pine	.09	.27	2.16	.10	.04	.05	.08	.47
Other softwoods	.02	.10	.03	1.62	.05	.06	.04	.06
Oaks	.54	.74	.52	1.32	.48	.76	2.78	1.70
Gums and yellow-poplar	.47	.29	.27	.20	1.54	2.31	.53	.55
Other hardwoods	.13	.17	.17	.80	1.81	2.09	.78	.63
All live species	4.60	4.14	3.52	4.30	4.12	5.29	4.47	4.28
Dead chestnut	-----	.10	.12	.73	-----	.97	.83	.50
All conditions:								
Loblolly and shortleaf pines	13.23	6.73	1.06	.38	.85	.03	.41	3.17
Virginia pine	.28	.55	4.34	.21	.06	.05	.13	.79
Other softwoods	.03	.13	.08	6.21	.78	.25	.08	.23
Oaks	1.41	1.48	1.30	2.73	1.44	2.16	4.75	3.00
Gums and yellow-poplar	1.69	.79	.70	.48	6.74	3.96	1.27	1.65
Other hardwoods	.47	.35	.37	1.48	4.60	3.96	1.54	1.36
All live species	17.11	10.03	7.85	11.49	14.47	10.41	8.18	10.20
Dead chestnut	-----	.12	.10	1.02	.03	1.40	1.06	.59

[1] Volume contained in cull trees and upper stems and limbs of hardwood and cypress saw timber is not included.

The Forest-Products Industries

THE forest resources of Virginia which have been described in preceding pages provide the raw material for numerous forest-products industries. For more than 300 years these forests have provided the people of Virginia with shelter, fuel, implements, and the means of livelihood. They still do so today—and not only Virginians but also the people of the Nation and, in some measure, the world. The purpose of this section of the report is to describe in some detail the variety and magnitude of these forest values in terms of commercial and domestic products and employment.

TABLE 12.—*Production or receipts of forest products, 1940, 1942, 1945* [1]

Product	1940		1942		1945	
	Active plants	Units [2] produced	Active plants	Units [2] produced	Active plants	Units produced
	No.	*M bd. ft.*	*No.*	*M bd. ft.*	*No.*	*M bd. ft.*
Lumber	2,004	1,049,800	2,618	1,213,900	------	994,700
Veneer logs	15	37,100	16	25,900	18	29,300
		Cords		*Cords*		*Cords*
Cooperage bolts	69	107,200	70	109,400	63	76,900
Pulpwood	9	834,300	9	876,800	9	823,500
Excelsior bolts	20	42,700	20	55,900	17	30,000
Tanning extract [3]	9	106,300	------	No data	9	64,600
Mine timbers	------	101,700	------	133,100	------	128,200
Fuel wood	------	3,897,100	------	3,610,000	------	3,261,500
Fence posts	------	113,300	------	113,300	------	99,600
Miscellaneous [4]	34	34,300	26	32,400	23	30,900
		M pieces		*M pieces*		*M pieces*
Poles and piles	------	128	------	160	------	157
Hewn ties	------	533	------	700	------	274
Total	2,160	----------	2,759	----------	------	----------

[1] Data on lumber production obtained in cooperation with Bureau of the Census; data on other products obtained by Forest Survey.

[2] Production is reported for lumber, mine timbers, fuel wood, fence posts, poles and piles, and hewn ties. Receipts at plants are reported for veneer logs, cooperage bolts, pulpwood, excelsior bolts, extract wood and bark, and miscellaneous products. Receipts include wood imported from other States.

[3] Includes chestnut wood and chestnut oak bark used for manufacture of tanning extracts.

[4] Includes plants making handles, turned wood products, insulator pins, shingles, dimension stock, boxes, picker sticks, wooden utensils, mine wedges, shuttle blocks, and cedar chests.

Important primary forest products processed in Virginia are lumber (which provides the major portion of value), veneer, pulpwood, extract wood, fuel wood, cooperage, excelsior, poles and piles, fence posts, cross ties, and mine timbers. The number of plants and volumes produced or received in 1940, 1942, and 1945 are shown in table 12. As has been noted previously, the forest-products industries as a group rank second among the State's manufacturing industries in number of employees and third in value of products.

Among the secondary forest-products industries the most important is the furniture industry, centered largely in Henry, Franklin, and Campbell Counties; and the paper industry (excluding pulp mills), making principally kraft paper, fiberboard, linerboard, and various types of paper containers. This report is chiefly concerned with the primary forest industries.

The Lumber Industry

From 1608 to the present day, lumber has been Virginia's most important forest product. The industry has progressed from the Tidewater to the farthest corners of the State—from the days of sash gang-saw mills, through the period of relatively few large band mills, to the present era of a host of small portable mills, many of which cut less than 10,000 feet a day and operate only a few months per year. Lumber production has averaged almost 1 billion board feet a year for the past 40 years. The first decade of

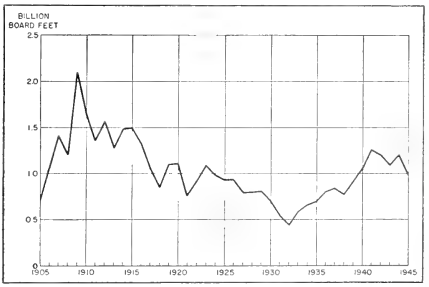

FIGURE 35.—*Lumber production in Virginia, 1905–45 (1905–39, Bureau of the Census; 1940–45, Forest Service in cooperation with Bureau of the Census).*

this period was marked by high production, culminating in 1909 in a cut of 2.1 billion feet. The second and third decades were characterized by a gradual decline to the low of 450 million feet in 1932. Since then the trend has been generally upward, fluctuating during the war years between 1.0 and 1.2 billion feet (fig. 35). The total lumber cut in the 41-year period, 1905–45, was 42.7 billion board feet, or 16 billion feet more than the total stand of saw timber in the State in 1940.

Logging

Cutting practices vary widely among the lumbering operations over the State, as is to be expected with such a variety of forest types, conditions, and terrain. Except on the larger operations in the Coastal Plain, and on most of the operations in the Mountain province, it is common practice to harvest most of the trees 10 inches and larger in diameter. In the mountains, over four-fifths of the softwood is cut from trees over 13 inches d. b. h., and over one-half of the hardwood from trees over 19 inches d. b. h. The three large mills in the Coastal Plain, cutting chiefly loblolly pine, cypress, tupelo, and white-cedar, also obtain most of their logs from pine trees above 13 inches d. b. h. and from cypress and tupelos above 16 inches d. b. h. White-cedar is commonly cut to a lower diameter limit.

Logging practice also varies, of course, with terrain, stand per acre, and size of mill. In all provinces, the small mills depend heavily on animals (fig. 36) for bunching logs in the woods and for skidding to the mill. Where the mill is too far from the timber for direct skidding, logs are often hauled by horses or mules, with the aid of "high wheels" or wagons, or by motortruck. The medium-sized mills, many of which are semipermanent, use animals for bunching in most cases, but depend more on trucks to haul logs to the mill. The few mills cutting over 5 million feet per year depend on more mechanical aids in logging, including steam skidders in the Dismal Swamp, and tractors (fig. 37) on drier ground. Mules or horses are also used for bunching in some locations. Truck (fig. 38) or railroad haul is the usual method of getting logs to the mill.

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FIGURE 37.—*Tractors are used by larger mills to skid logs to road or railroad.*

The source of sawlogs varies considerably among the provinces and by size of mill. In 1940, for the State as a whole, 54 percent of the logs were from purchased stumpage, and 17 percent were cut under contract at a fixed rate per thousand board feet. Only 15 percent came from mill-owned land, 9 percent were purchased on a "delivered-at-mill" basis, while the remaining 5 percent were custom-sawn (table 13). These ratios are believed to be approximately the same now. Only in the mountains is custom sawing an important source of logs, while contract sawing is most important in the Piedmont. In all units, purchased stumpage

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FIGURE 36.—*Horses or mules are commonly used throughout the State to bunch logs.*

F–441805

FIGURE 38.—*Trucks are being used increasingly to get logs to the mill. Note metal airfiled landing mats on roadway.*

provides about half the logs. The data on source of logs by size of mill reveal that only the largest mills obtain any appreciable volume of logs from their own land.

TABLE 13.—*Source of sawlogs by physiographic province, 1940*[1]

Source of sawlogs	Coastal Plain	Piedmont	Mountains	State
	Percent	*Percent*	*Percent*	*Percent*
Mill-owned land	18	9	16	15
Purchased stumpage	56	56	44	54
Purchased logs	12	6	8	9
Contract sawing	13	24	15	17
Custom sawing	1	5	17	5

[1] These percentages are believed to be approximately correct for 1945 also.

Lumber Manufacture

Accurate information on lumber production was obtained for 1942 through a complete canvass of all sawmills by the United States Forest Service in cooperation with the Bureau of the Census, the War Production Board, and other public agencies. The survey showed that 2,618 sawmills produced 1.2 billion board feet of lumber. Of these, only 9, producing more than 5 million board feet per year, could be classed as large mills. The remainder, mostly small mills, (fig. 39) producing an average of 8,000 board feet or less daily, produced 89 percent of the lumber (table 14). Every county in the State had at least 4 active sawmills; some counties had over 80 (fig. 40).

The 1.2 billion board feet produced in 1942 is no index of the potential capacity of the State's sawmill industry. By activating the more than 650 idle

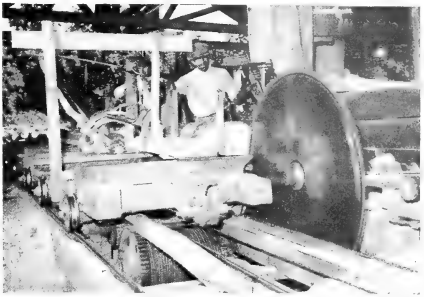

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FIGURE 39.—*A typical medium-size stationary sawmill, capacity 15,000 board feet per day.*

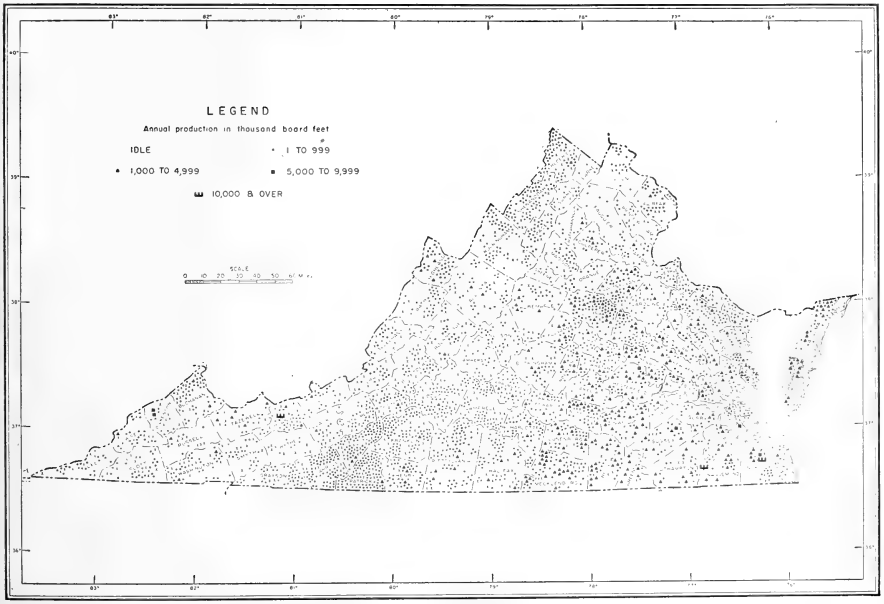

FIGURE 40.—*Location of sawmills in Virginia, 1942.*

mills, by operating full time with a full crew of labor not available in 1942, and with adequate logging and milling equipment likewise not available during the war, production could probably be tripled or quadrupled—if a sufficient supply of timber were available.

TABLE 14.—*Number of sawmills and lumber production by mill class, 1942*

Range of annual production (M bd. ft.)	Sawmills			Total lumber production			
	Number	Average daily production	Average operating time	Softwoods	Hardwoods	Total	
		M bd. ft.	*Days*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*Percent*
Idle	657						
1–49	613	2	11	5,226	8,073	13,299	1.1
50–499	1,219	3	56	115,443	117,830	233,273	19.2
500–999	460	5	132	228,035	98,498	326,533	26.9
1,000–4,999	317	8	189	382,177	122,736	504,913	41.6
5,000–9,999	6	28	258	27,606	16,117	43,723	3.6
10,000+	3	114	269	54,669	37,487	92,156	7.6
Total	3,275	6	76	813,156	400,741	1,213,897	100.0

Although there is ample unused capacity, the great majority of Virginia's small sawmills are not equipped or operated efficiently enough to produce high-grade lumber. Neither do they efficiently utilize the logs they saw. Thus, the production of rough-sawn, ungraded, and green lumber is accompanied by large losses in slabs, edgings, and sawdust. Unfortunately, nearly one-half of Virginia's saw-timber acreage is so poorly stocked as to be considered inoperable except by small mills. The result is economic waste of an already depleted resource. But this does not mean that a small mill must be inefficient. It is logical to assume that a small mill can be efficient and operate in such stands.

Concentration yards are an essential adjunct to the small-mill industry. A majority of the smaller mills sell their lumber—generally rough, green, and none-too-well manufactured—to these yards, where it is assembled, dried, graded, and dressed for the market. In some instances the concentration yard buys rough lumber directly from the sawmills; in others the yard owns mills outright or finances them in whole or in part, the mill cutting on contract for the financing yard. There is no fixed pattern of relationship for either the yards or mills. In 1946 there were about 100 concentration yards in Virginia, 85 of them in the Piedmont and Coastal Plain, and about 15 in the mountains. These yards perform a highly useful service in preparing lumber in the form desired by the consumer, and in providing a central market for the output of many small scattered producers. Yet it is also true that their presence provides an incentive for overcutting and for wasteful mill practice. When yards are concentrated, competition for timber is increased as the demand for stumpage is localized. Since the common yard practice is to buy mill-run lumber, the mill owner has little incentive to grade-saw his product or otherwise improve its quality by better manufacturing processes.

In 1945 about two-fifths of the year's output of lumber came from the mills of the Coastal Plain. The Piedmont's mills produced almost the same volume; the mills in the mountains contributed less than one-

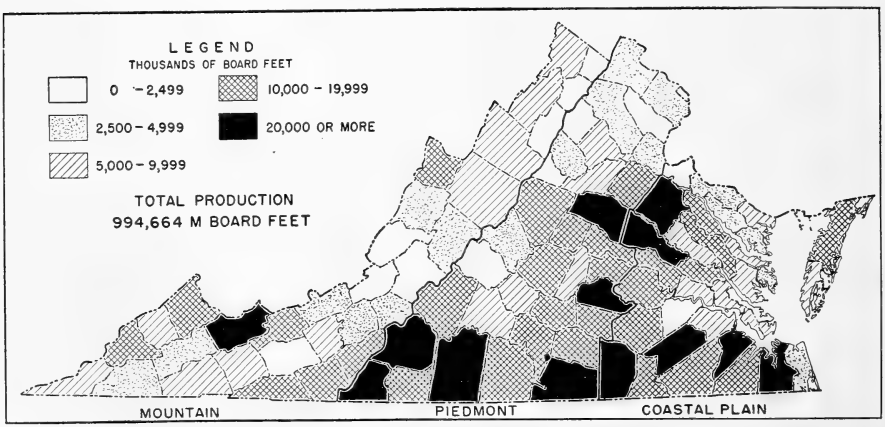

FIGURE 41.—*Approximate lumber production by county, 1945.*

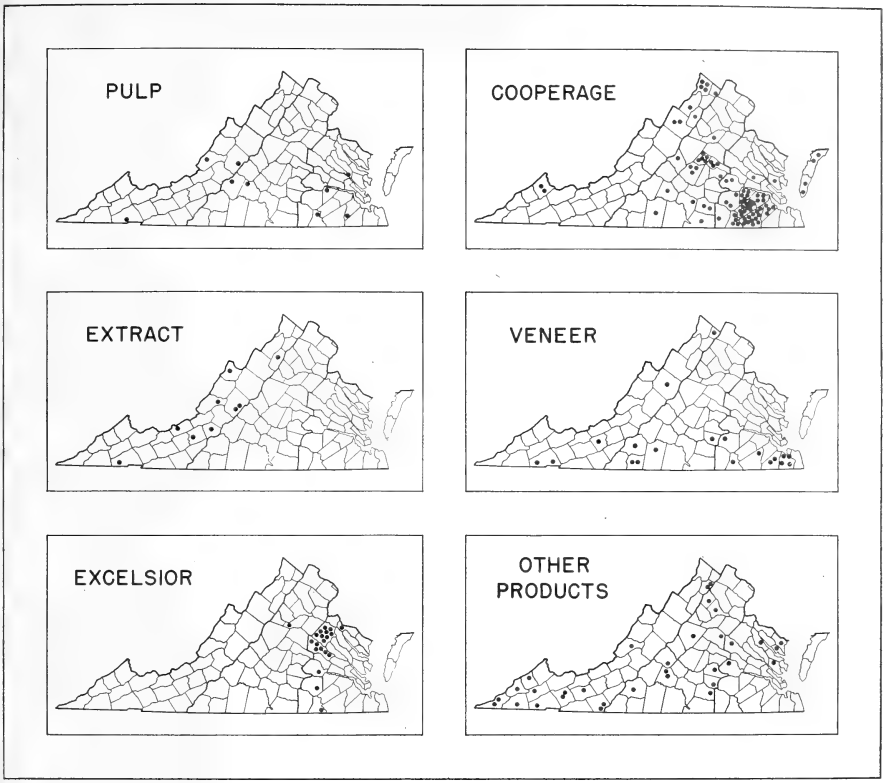

FIGURE 42.—*Location of active and idle forest-products plants other than sawmills, 1945.*

fourth of the cut. Approximate lumber production by counties is shown in figure 41.

Loblolly, shortleaf, and Virginia pines made up 49 percent of the total lumber production in Virginia in 1945, other softwoods (white pine, cedars, hemlock), 6 percent. Oaks comprised 27 percent, gums and yellow-poplar 12 percent, and other hardwoods 6 percent.

Veneer

The veneer industry was represented in Virginia in 1945 by 18 operating plants: 8 in the Coastal Plain, 5 in the Piedmont, and 5 in the mountains (fig. 42). It consumed 29.3 million board feet of veneer logs, of which 10.7 million board feet came from outside Virginia. These imports were partially offset by exports of 1.3 million feet to North Carolina. The Coastal Plain plants consumed 56 percent of the total, Piedmont plants 18 percent, and those in the mountains 26 percent.

The principal product was commercial veneer for furniture (fig. 43), with smaller amounts of container veneer for fruit and vegetable baskets, shipping-box veneer, and plywood. Practically all of the commercial veneer and most of the other types were sold to the local market, in which the State's extensive furniture industry was the largest buyer.

Of the total consumption of 29.3 million board feet, three-fourths was gum and yellow-poplar, about one-tenth was other hardwood, and 6 percent was oak.

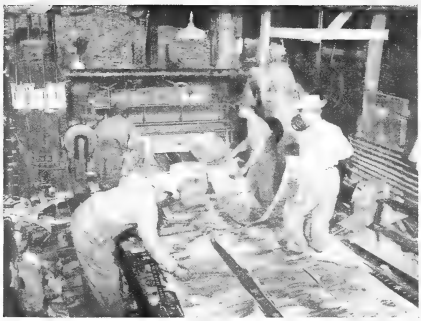

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FIGURE 43.—*Rotary-cut veneer for furniture is the principal product of the State's veneer industry.*

Softwoods provided the remainder. The largest center of production was in the southeastern part of the State (fig. 44).

Veneer plants have a more difficult log-procurement problem than sawmills. Veneer bolts, because of the higher quality and the larger diameter trees required to produce such quality, bring higher prices than sawlogs. They are bought delivered at the plant or on cars for shipment; few plants own their own timber or buy stumpage. Because the proportion of woods-run logs suitable for veneer is low, except for yellow-poplar, most plants draw material from a wide territory. About 75 percent of the log volume is hauled an average of 46 miles by truck to the plants, the remainder an average of 15 miles by truck to a railroad.

Wood Pulp

In 1946 Virginia's nine wood-pulp mills (fig. 42) had the plant capacity to produce over 1,770 tons of pulp every 24 hours. Several pulping processes are used, but the sulfate process accounts for 78 percent of the pulp produced. Four of the mills use this process. Two mills use the soda process to make hardwood pulp for book, writing, and other white papers; one mill makes insulating board from pine groundwood, one uses the semichemical process for converting chestnut into linerboard; while one groundwood and semichemical mill produces corrugating board (fig. 45).

In 1945 these nine mills purchased 823,500 standard cords [8] of pulpwood, of which 73 percent was yellow pine and 27 percent was hardwoods, principally gum, yellow-poplar, chestnut, and oak, fig. 46). Pine will undoubtedly continue to be the principal source of Virginia's pulp for a long time to come.

While some of the mills own fairly large tracts of timber, more than three-fourths of their pulpwood is obtained from other lands, almost all of it under the contract system. Under this system, the pulp company enters into contracts with a number of individuals who agree to supply the mill with a stated amount of pulpwood each month or week. The system is extremely variable—some contractors buy boundaries of timber and furnish the labor and equipment to harvest it; others subcontract with truck operators or

[8] The standard cord contains 128 cubic feet; the more commonly used "unit" contains 160 cubic feet.

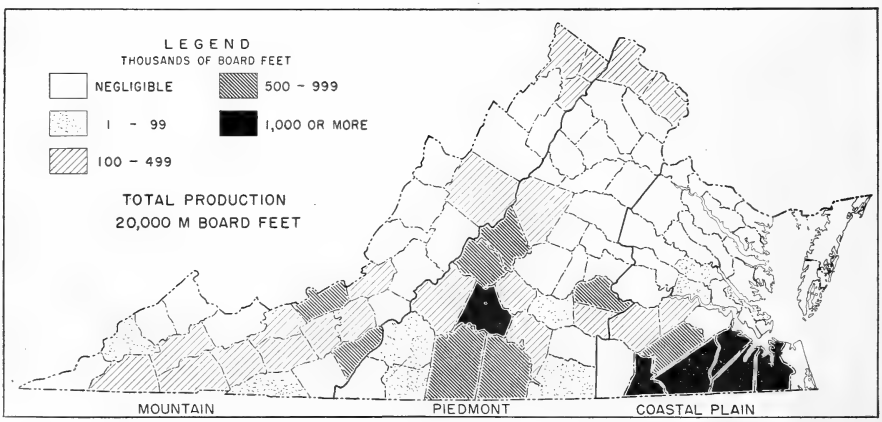
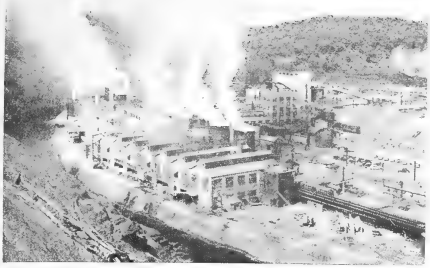


FIGURE 44.—*Veneer log production by county, 1945.*



F-441868

FIGURE 45.—*One of the larger of Virginia's nine wood-pulp mills.*

F-441878

FIGURE 46.—*Even a small pulp mill requires a large amount of wood annually. In 1946 the State's nine plants purchased more than 1 million cords.*

with individual timber owners to deliver pulpwood to the mill, and others buy it at the roadside or loaded on cars. By whatever means the wood is procured, the contractor gets a fixed fee per unit delivered at the mill for wood from his district. The price of pine pulpwood, f. o. b. mill, was $9 to $10 per cord in late 1946. In the same period pulpwood stumpage was valued at $2 to $2.50 per cord, or even higher in some locations.

Transportation costs have always been an important factor in pulpwood costs. They set the limits to procurement areas. About 30 miles is the economical limit for truck haul, but railroad hauls of 200 or more miles, and barge hauls of 50 or more miles, are not uncommon. Differentials in rail-freight costs have created strange procurement patterns. For example, a pulp mill 200 miles from a source of wood may compete successfully with a mill only 40 miles from the same source, because the first mill has a one-line haul whereas the second mill has a two-line haul. A mill may pay less in transportation cost for a unit rail-hauled 150 miles than for a unit truck-hauled only 25 miles. In general, however, pulpwood production is greatest relatively close to operating plants (fig. 47).

Cooperage

Measured by number of plants, cooperage production is Virginia's leading nonlumber forest industry, but it ranks far below the pulp industry in volume of wood used. In 1945, the 63 active plants (fig. 42) obtained 76,900 cords of wood, chiefly loblolly pine.

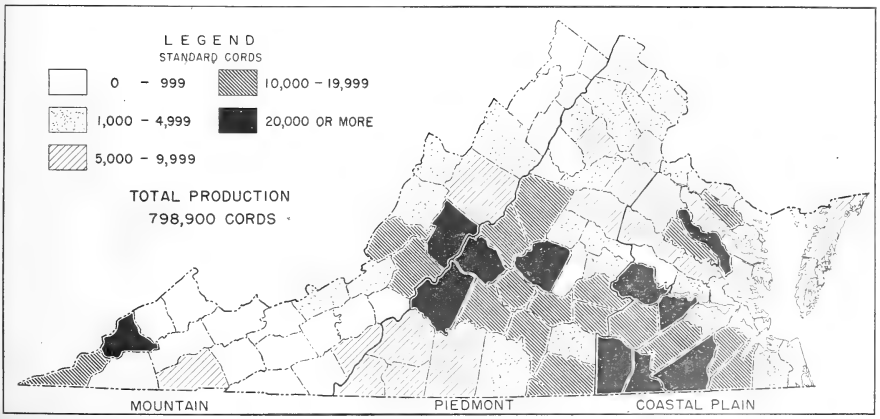


FIGURE 47.—*Pulpwood production by county, 1945.*

F-441769

FIGURE 48.—*Nail-keg staves are the principal product of the cooperage industry.*

About 8 percent was hardwoods. Of the total consumption, 74,300 cords was produced in Virginia, the rest being imported from North Carolina. At the same time 500 cords was exported to North Carolina.

Nail-keg slack staves (fig. 48) are the principal product, but small amounts of slack staves for potato barrels and tobacco barrels, and tight staves for whisky barrels are also produced. The industry is centered in Southampton, Sussex, and Greenville Counties of the Coastal Plain (fig. 49). Here 70 percent of the plants (fig. 50) consume 81 percent of the wood used by the industry in Virginia.

F-441775

FIGURE 50.—*Cooperage plants are small, but in 1945 they used 76,900 cords of wood.*

Although a few companies own sizable tracts of timber, almost all the wood used is purchased as stumpage, usually on a lump-sum basis. While trees from as small as 6 inches d. b. h. up to 20 inches are used, most of the wood for nail-keg staves comes from trees 8 to 12 inches in diameter.

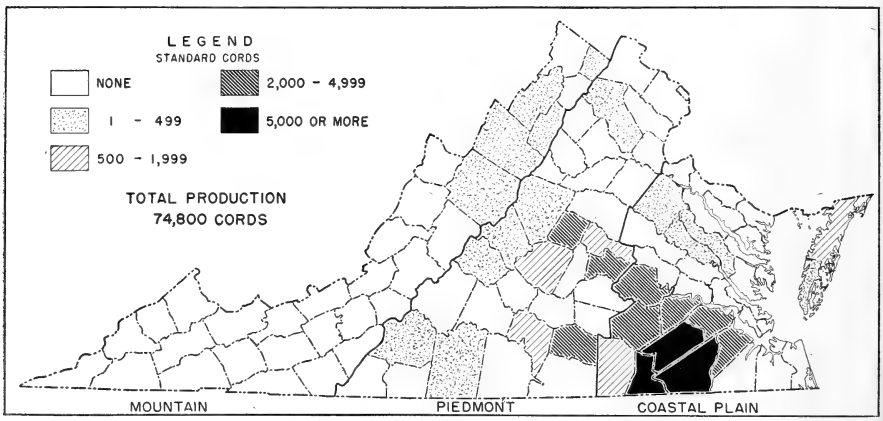


FIGURE 49.—*Cooperage-bolt production by county, 1945.*

Excelsior

More than a third of all the excelsior plants in the United States are located in Virginia, all but one in the Coastal Plain, with 14 of the 17 operating plants in Caroline and Hanover Counties. In 1945, these 17 plants (fig. 51) used 30,000 cords of wood, almost entirely loblolly pine. Wood is purchased in 180-cubic-foot units of peeled wood 5.25 feet long. The bolts are required to be straight-grained and reasonably clear; pieces 4 to 6 inches in diameter from fast-growing trees are preferred.

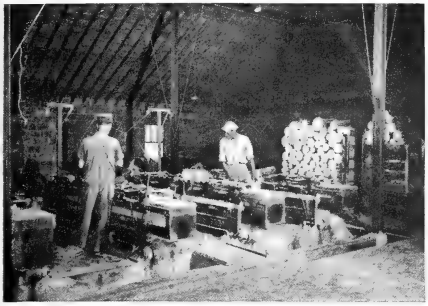


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FIGURE 51.—*Excelsior plants are concentrated in Hanover and Caroline Counties. This plant uses a maximum of 10 cords of wood a day.*

Tanning Extract

Nine plants in Virginia manufacture tanning extract from chestnut wood and chestnut oak bark (fig. 42). Five of these plants use oak bark only (fig. 52), two use chestnut wood only, and two use both raw materials. In 1945 they purchased 64,600 cords of wood and bark, of which 5,700 cords (9 percent) was oak bark and the rest chestnut wood. None of this use, of course, constitutes a drain on the growing stock. Total production of extract wood in Virginia was 51,850 cords, the balance being brought in from surrounding States. Wood is purchased in 160-cubic-foot units, while bark is usually purchased by weight. The plants using chestnut are entirely dependent on dead trees, since the chestnut blight has killed all but a few scattered small trees.

However, a considerable volume of usable dead chestnut remains. A special survey made in 1942 in the whole southern Appalachian region showed that about 2.7 million units of accessible dead chestnut were available to plants in Virginia, equivalent to 15 years' supply at full capacity. By 1960 it is probable these plants will have ceased operations, leaving oak bark as the chief local source of tannin. The industry is confined to the Mountain province, where the two species are most common.

F-441870

FIGURE 52.—*Chestnut oak bark is one of the sources of material for the tanning-extract industry.*

Poles and Piles

In 1945 pole and pile production amounted to about 157,000 pieces, of which 144,000 were pine, chiefly loblolly. Two thousand pieces of oak, 7,000 of yellow-poplar and gum, and 4,000 of other species comprised the remainder. The Coastal Plain supplied 83 percent of all poles and piles and the Piedmont the rest. In 1940 it was estimated that Virginia had about 40 million trees (half of them in the Coastal Plain) that would meet specifications of the American Standards Association for poles and piles. Although the Norfolk area and the Eastern Shore are noted for their production of long poles and piling, only 9 percent of the trees in this area would make sticks over 35 feet long.

Even at prewar prices the net return from the sale of one pole greatly exceeds that from the same volume of pulpwood. The landowner in the Coastal Plain and southern Piedmont generally would be ahead by disposing of his tall, straight, and cylindrical trees for poles or piles rather than for pulpwood or even sawlogs.

Fuel Wood

Between 3 and 4 million cords of fuel wood are used annually in Virginia for heating, cooking, and curing tobacco (fig. 53). This is the largest single use of wood, exceeding even lumber, but only a portion of the consumption represents drain on the growing stock. The exact volume for any one year cannot be accurately determined because of difficulty in obtaining an adequate sample and because fuel cut varies with the severity of the winter. Most fuel wood is cut by users from their farm woodlands (fig. 54), but use of mill waste has increased sharply since 1940. On the basis of 1945 estimates, about three-fifths of the fuel wood cut from living trees came from hardwood species. By source of wood, 35 percent was mill waste, 40 percent came from tops and limbs, dead and cull trees, and the remaining 25 percent from sound growing trees. Farm families consumed an average of 11.7 cords per family, rural nonfarm families 6.7 cords, small-town families 4.4 cords, and urban families 0.1 cord per year.

F-441835

FIGURE 53.—*Curing tobacco required 154,000 cords of wood from living trees in 1945.*

Fuel wood ranks third as a source of drain on the pine growing stock of the State. In 1945, 329,000 cords of pine fuel wood was cut from sound, growing trees. The total pine pulpwood drain from Virginia's forests in the same year was 590,500 cords, while the lumber industry used the equivalent of 1,305,500 cords of pine.

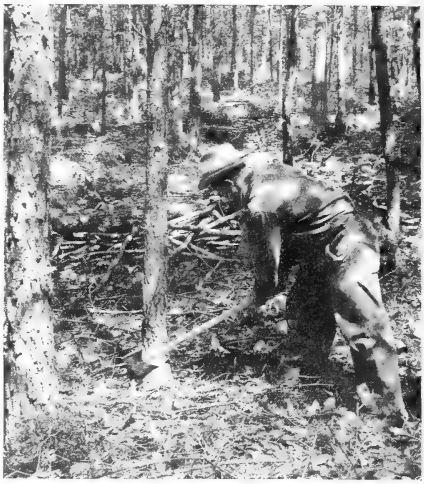

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FIGURE 54.—*More than 800,000 cords of fuel wood was cut from sound, live trees in 1945.*

Mine Timbers

Virginia's extensive coal-mining industry, which produces from 15 to 20 million tons of coal annually, requires a wide variety of wood products, both rough and dressed. These include rough mine props, cap boards, brattice lumber, wedges, mine ties, and other miscellaneous products. Brattice lumber and sawn ties are included under the lumber industry, mine wedges, hewn ties, and other miscellaneous mine products under "miscellaneous industries." Mine props and cap boards are included under "mine timbers." In 1945 more than 128,000 cords of wood were used for mine timbers. Almost any species is acceptable, but props must be sound, at least 5 inches in diameter at the small end, and from 3 to 16 or more feet long. Pieces larger than 8 inches in diameter are generally split in half, and those over 14 inches are quartered. In 1945, 78 percent of mine timbers were hardwood and 22 percent softwood. Oaks, hickory, chestnut, maple, yellow-poplar, and locust were the chief hardwood species used.

Because of labor shortages during the war and the

increasing scarcity of desirable stumpage in the coal region, imports of mine timbers into the principal coal-producing region (southwestern Virginia) from the Piedmont increased sharply. Some companies now import most of their timbers from the Piedmont, principally from Buckingham, Appomatox, and adjacent counties—a rail-haul of about 200 miles. Others contract for the production of timbers from their own land, while still others contract for timbers delivered at the mine by truck or rail.

Fence Posts and Hewn Ties

Production of fence posts in 1945 totaled 99,600 cords, chiefly cedar and cypress among the softwoods, and locust, oak, and mulberry among the hardwoods. Hewn ties produced numbered 274,000 pieces, all but 1 percent of which were oak.

Miscellaneous Industries

Included in this category are industries producing handles (fig. 55), insulator pins, dimension stock, boxes, picker sticks, wooden utensils, shuttle blocks, and cedar chests. The 23 plants so engaged in 1945 used 30,900 cords of wood. Total production in Virginia of material for miscellaneous products was 16,200 cords. An equal amount was imported from other States, while 1,500 cords was exported.

A wide variety of species is used. Handles are made chiefly from hickory, ash, maple, and oak; boxes from pine and yellow-poplar; chests from redcedar; shuttle blocks from dogwood; picker sticks from hickory; insulator pins from locust; and utensils from redgum. The production in cords for these miscellaneous industries and the excelsior industry is shown by counties in fig. 56.

F-441886

FIGURE 55.—*Handle blanks are an important item among the miscellaneous-products industries. These are hickory blanks for hatchet handles.*

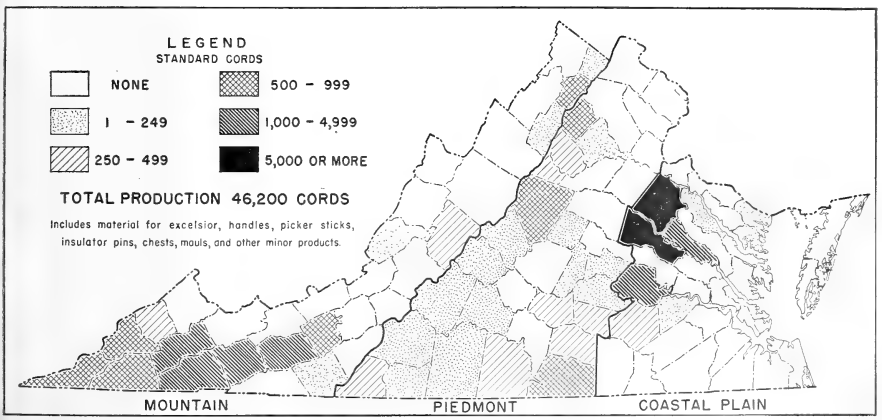

FIGURE 56.—*Production of material for excelsior and miscellaneous products by county, 1945.*

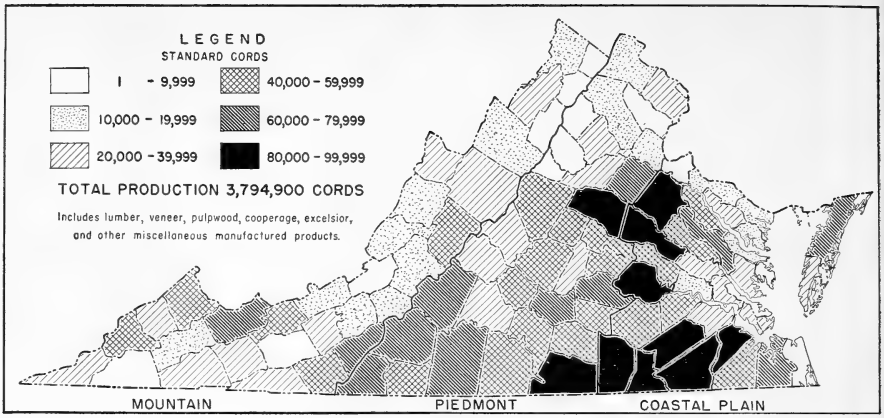

FIGURE 57.—*Total production for lumber, veneer logs, pulpwood, cooperage bolts, excelsior, and miscellaneous manufactured products by county, 1945.*

Summary of County Production

Figure 57 shows the total 1945 production in standard cords for all the listed products (lumber, pulpwood, veneer logs, cooperage bolts, excelsior, and other miscellaneous manufactured products) in each county of the State. County data are not available for fuel wood, fence posts, poles and piles, and other hewn products.

It is evident that production is concentrated (1) in the southeastern part of the State in a broad belt along the fall line which separates the Coastal Plain from the Piedmont, and (2) along and immediately adjacent to the southern part of the Blue Ridge. With two exceptions (Tazewell and Accomac Counties), all of the counties producing more than 60,000 cords of material lie in one or the other of these two areas. The Coastal Plain produced two-fifths of the total production of 3.8 million cords, the Piedmont an equal amount, and the Mountain province the other one-fifth.

Employment

Accurate information on the number of workers employed in the forest-products industries is almost impossible to obtain because of the small size and widely scattered distribution of many of the plants, and because so much of the labor is on a part-time basis. Much of the part-time labor force consists of farmers who work intermittently in woods or plants during slack periods on the farm.

A special study made by the Forest Service in cooperation with the War Production Board (*8*) indicated that as of July 1, 1944, slightly more than 39,200 workers were engaged in producing primary forest products, excluding fuel wood, as follows:

	Number
Woods workers:	
Sawlogs, veneer logs and bolts	6,950
Pulpwood	5,780
All other	5,730
Total	18,460
Plant workers:	
Sawmills and concentration yards	12,390
Pulp and related processing	5,020
Plywood and veneer	1,270
Cooperage stock	960
Tanning extract	780
Shingles	10
Handle blanks	130
Excelsior	140
Shuttle blocks	20
Miscellaneous	40
Total	20,760

Of the total number, 47 percent were employed in the woods and 53 percent in the plants. These figures do not include workers in secondary forest industries such as furniture, paper making, and box plants. The average annual wage in forest-products industries in 1943 was $1,015 (*5*) and, based on that rate, the total forest industry pay roll for 1944 may be estimated at $39,800,000.

Logging and Milling Waste

Reference has already been made to the excessive waste occurring in both woods and manufacturing plants. It is a problem of forest management and utilization, the solution of which would provide raw materials for new industries and reduce the drain upon the present timber stands. A special study reveals the extent of logging and milling waste in the primary forest industries of Virginia in 1944. Gross waste, that is, the total volume of material not utilized for the finished product of a given industry, is distinguished from net waste, which is defined as the volume of material which is not used for any purpose.

The net waste consists of 86 million cubic feet of logging waste and 48.3 million cubic feet of milling waste (table 16). The largest single source of waste is the portion of the tree left in the woods, in stump, tops, cull or broken logs, or in incomplete utilization of the stem. This waste amounted to nearly 61 million cubic feet, nearly one-half of the total net waste, and nearly three-fourths of all logging waste. The second largest source of waste is in sawdust and shavings in the processing plants, 31.4 million cubic feet, nearly a fourth of all waste, and 65 percent of all milling waste. Sixteen percent of all waste came from trees destroyed in logging, and 13 percent from slabs, edgings, trimming, and similar waste in the processing plants. An additional 2 percent was in uncut inferior trees which could have been utilized, but which would die soon after the logging.

Because the lumber industry is by far the largest forest industry, it accounted for 78 percent of total net waste. Fuel wood, pulpwood, hewn cross ties, and cooperage-stock production, in that order, were the next largest contributors, these with lumber accounting for 94 percent of all net waste (table 16). The ratio of total net waste (134.3 million cubic feet) to total drain (350.6 million cubic feet) was 1 to 2.61; that is, for every 261 cubic feet of finished product there was 100 feet of completely unutilized waste.

Quite obviously, the forest industries, dealing with a scattered resource like timber, subject to wide variations in quality and adaptability for specific products, cannot be expected under present supply and demand relationships and values to achieve 100-percent utilization of their raw material. Nevertheless, only 73-percent utilization of a critical resource like timber is too wasteful. Continuing research to point out the way to reduce this waste is needed. The degree of utilization could be increased by more complete use of the tree in the woods—lower stump, use of a longer portion of main stem, more careful bucking for cull, and use of more of the tops for pulpwood, fuel wood, and small-dimension stock. Since the unused portions of trees left in the woods account for nearly half the net waste, the greatest savings would be made here by improved management and logging practices. Only if, by such practices, the operators can reduce costs, or obtain a higher yield of salable product at the same cost, will such improved practices be adopted. Use of sawdust and shavings, the second largest source of waste, is more difficult at present but far from hopeless. This waste product, except for cost of transportation, is cheap and in a form that can readily be cooked, digested, or otherwise converted. As such it can be used for producing alcohol, wallboard, and other converted products. The same is true of most of the other milling wastes.

TABLE 16.—*Net logging and milling waste in primary forest industries, 1944*

[Thousand cubic feet; i. e., 000 omitted]

Kind of product	Logging waste				Milling waste			Total waste	
	Part of cut tree left in woods	Trees destroyed in logging	Sound inferior trees uncut which will soon die	Total logging waste	Slabs, trimmings, edging, etc.	Sawdust, shavings, other fine materials	Total milling waste	Volume	Percent of total
Lumber	43,662	14,714	2,308	60,684	15,883	27,888	43,771	104,455	77.8
Fuel wood	4,915	2,854	291	8,060				8,060	6.0
Pulpwood (logging only)	4,349	2,099	584	7,032				7,032	5.2
Cross ties (hewn)	2,431	507	73	3,011	1,038		1,038	4,049	3.0
Poles and piles	488	166	28	682				682	.5
Cooperage stock	147	37	11	195		2,620	2,620	2,815	2.1
Tannin and chemical wood	184	308		492				492	.4
Posts	1,051	281	19	1,351		493	493	1,844	1.4
Veneer	1,096	242	34	1,372		51	51	1,423	1.1
Round mine timbers	1,827	387	13	2,227				2,227	1.6
Other	686	131	47	864		358	358	1,222	.9
All products	60,836	21,726	3,408	85,970	16,921	31,410	48,331	134,301	
	Percent 45.3	*Percent* 16.2	*Percent* 2.5	*Percent* 64.0	*Percent* 12.6	*Percent* 23.4	*Percent* 36.0		100.0

Forest Increment and Commodity Drain

PREVIOUS sections have reported the volumes and kinds of timber in the State and the industries and enterprises dependent on this raw material. These facts by themselves, however, do not reveal whether the forest capital (growing stock) is being expended at an excessive rate or whether growth is sufficiently in excess of drain to increase the capital. This section of the report sets up a balance sheet of growth and drain and evaluates some of the conflicting trends that make an appraisal of the forest situation extremely difficult.

Forest Increment

In all calculations of forest increment, three elements are factors—gross increment, mortality, and net increment. Gross increment is the increase in volume of the growing stock in saw-timber or cordwood trees uncorrected for losses by mortality or deterioration, plus the volume in smaller trees reaching the minimum diameters for these classes during the year. Mortality is the loss due to such causes as fire, wind, insects, disease, and suppression, but not from cutting. Net increment is the difference between gross increment and mortality.[9]

Mortality

In 1940 the net volume of trees 5.0 inches d. b. h. and larger that died during the year amounted to 579,000 cords. Of this total, 331,000 cords were softwoods and 248,000 cords were hardwoods. The softwood mortality amounted to 8 percent of gross growth and the hardwood to nearly 6 percent. Losses of over one-half million cords per year are serious enough in themselves but equally disturbing is the great but unmeasured mortality of the seedlings and saplings less than 5 inches in diameter brought about chiefly by forest fires.

In terms of saw timber, mortality amounted to 85 million board feet, 53 million of softwoods and 32 million of hardwoods. This was 6 percent of the gross growth of softwoods and 4 percent of that of the hardwoods.

It is almost impossible to obtain a quantitative measure of mortality by causes because of the difficulty in assigning reason for death to individual trees. In addition, the number of seedlings and small saplings completely destroyed by fire, for example, cannot be measured accurately on a State-wide basis without a prohibitive amount of field work extending over several years. However, careful observation of each dead tree tallied on the survey plots, distributed throughout the State, led to the conclusion that fire, insects, disease, and wind, including sleet damage, were the major causes of tree mortality in Virginia. Logging, natural suppression, and lightning appeared to be less important causes.

Wild fire may not be the leading cause of death of trees larger than 5.0 inches d. b. h., but certainly it is one of the most important. Not only does it kill out-

F-441810

FIGURE 58.—*Eight-year-old loblolly pine totally destroyed by spring fire, 1946.*

[9] For more detailed definitions of increment and drain, see Definitions of Terms Used, in the Appendix, p. 57.

right many young trees (fig. 58), and in severe fires mature trees also (fig. 59), but it damages in a greater or less degree many more than it kills. Thereby the difficulties of management are increased, since volume production of good timber is reduced, cull volume requires removal, often at a loss, and in many cases the produc-

F-441813

FIGURE 59.—*Shortleaf pine saw timber totally destroyed by crown fire, April 1942.*

tivity of the site is reduced. Fire also exposes the mineral soil by destroying litter and humus, thereby causing increased erosion and storm runoff—forerunners of silting and floods. Recreational values may be reduced, and in severe fires, game and fish are killed and their habitat ruined.

Most Virginia fires are surface fires, burning along the ground. Crown fires are rare, but do occur in severe fire seasons in all parts of the State. In the coastal swamps, peat and muck fires occur, often requiring dug trenches to suppress them. The spring fire season extends from February 1st in the Coastal Plain to May 15th in the mountains, culminating in April for the State as a whole. During this period most of the year's fires occur. The fall fire season is shorter, culminating in November.

Effective in 1946, all of Virginia's 14.8 million acres of forest land was under organized protection by Federal or State agencies, cooperating on private land with the county governments and individual landowners. Prior to this year, the 5-year (1940–44) average of area protected was 13,419,000 acres. In this 5-year period, on State and private land under protection, there was an average of 2,597 fires per year, or 220 fires per 1 million acres protected. These fires burned an average of 105,700 acres annually, or only 0.9 percent of the area protected. This is a good protection record.

Great variation exists between various parts of the State, and from year to year. In seven counties in the extreme southern Piedmont, for example, only 0.6 percent of area protected burned over during this period, while in four counties in extreme southwest Virginia in the mountains, 1.5 percent burned over. In 1942 in the State as a whole, 2.1 percent burned over, a total of 237,400 acres, whereas in 1944 only 0.2 percent (28,800 acres) burned.

Among insect enemies of living trees the most destructive in Virginia is the southern pine beetle (*Dendroctonus frontalis*). "During the past 55 years, at least seven notable and costly outbreaks of the southern pine beetle have caused a marked drain on the forest resources of the State. An exact estimate of such cannot be given. . . . From the records available, it appears that the quantity of timber killed ranged from 1 to 9 million board feet per outbreak. During the period 1930–33 in Fairfax County alone 5 million board feet of pine was destroyed. In Southampton County an additional 3 million board feet of merchantable timber was killed, and in King and Queen County 1 million feet was killed in the same period. During the 1936–38 outbreak, extensive damage also occurred in the southern counties (fig. 60). The beetle is again active in these counties." [10] Extensive damage is also done by bark beetles of the genus *Ips*, which generally attack cut or down timber, but in summer frequently attack living trees on logging operations or following fire damage.

Forest diseases [11] in Virginia take a heavy annual toll through mortality, cull, and degrade. The unprecedented destruction of billions of feet of chestnut by the blight fungus provides a striking example of what a forest tree disease can do. In the aggregate the losses caused by our native diseases and decays that whittle continously on our timber capital are ulti-

[10] St. George, R. A., Entomologist, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, in statement prepared for this report, January 1946.

[11] This statement on tree diseases in Virginia was prepared by George H. Hepting, pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, and cooperator, Southeastern Forest Experiment Station.

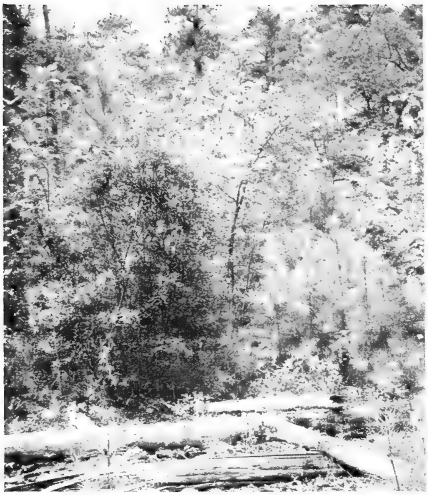

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FIGURE 60.—*This opening in the overstory resulted from killing of mature trees by the southern pine beetle. Note reproduction seeded in from surrounding trees.*

FIGURE 61.—*The littleleaf disease of pine, chiefly affecting shortleaf pine, is prevalent in the southern Piedmont.*

mately greater than those resulting from the spectacular epidemics.

Losses from the white pine blister rust, which occurs generally over the western part of the State, have been small, due in part to the natural lack of concurrence of ribes and white pine over most of the area, and to the timely eradication of currant and gooseberry bushes where they occurred on important white pine areas. Another white pine disease, called needle blight, the cause of which is unknown, has been causing extensive browning of foliage and some mortality in Virginia. Research has just been started to determine the nature and potentialities of this disease. Strumella and *Polyporus hispidus* cankers, by weakening the stem, result in breakage of thousands of oaks annually in the mountain region. The fusiform rust (*Cronartium fusiforme*) also causes breakage of loblolly pine in the coastal area.

The littleleaf disease, primarily affecting shortleaf pine, and to a lesser extent loblolly, occurs in 13 Virginia Piedmont counties and is causing serious mortality and substantial reductions in growth in many areas (fig. 61). Stands affected by littleleaf disease under annual observation in Cumberland and Buckingham Counties have steadily deteriorated over the past several years. Where this disease occurs, it must be reckoned with in management plans, and diseased trees must be removed periodically to salvage them before they die. The cause of littleleaf is still unknown, and no measures other than through salvage have yet been found to reduce its losses.

Winds of hurricane force which blow down timber stands over wide areas are seldom experienced in Vir-

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FIGURE 62.—*Glaze damage to pine in the Coastal Plain is severe at intervals of several years.*

ginia, but there is a steady, and, in the aggregate, a large loss of volume from local windstorms that blow down scattered individual trees. This loss occurs in all parts of the State. Although not strictly wind damage, additional losses are caused by glaze storms which seem to occur on the average about once a decade. Damage is particularly severe on the southern yellow pines (fig. 62), and trees 6 to 10 inches in diameter suffer especially from bole and top breakage and are frequently uprooted. When strong winds occur while the trees are still weighted with ice, damage is even more severe.

Net Board-Foot Increment

In 1945, the net increment of the saw timber in Virginia's forests was 1,744 million board feet (International ¼-inch rule). Slightly more than half was softwood, or 923 million feet (table 17). Nearly two-fifths of the total was in loblolly and shortleaf pines alone. Oaks contributed one-fifth, gums and yellow-poplar nearly one-fifth, and all other species the remainder.

TABLE 17.—*Net increment of saw timber by species group and province, 1945*

Species group	Coastal Plain	Piedmont	Mountain	State
	Million bd. ft.	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*
Softwoods:				
Virginia pine	37	164	18	219
Other yellow pines	490	157	21	668
Other softwoods	6	7	23	36
Total	533	328	62	923
Hardwoods:				
Oaks	82	168	102	352
Gums and yellow-poplar	134	147	37	318
Other hardwoods	45	58	48	151
Total	261	373	187	821
All species	794	701	249	1,744

The Piedmont forests were growing at the fastest rate, chiefly because of the high growth rate of the Virginia pine type in this province. The Coastal Plain forests were second, and those of the mountains a poor third. For the State as a whole, net annual increment was nearly 7 percent of the saw-timber growing stock.

Net Increment of Entire Stand

The 1945 net increment on all sound trees 5.0 inches d. b. h. and larger, including the saw timber previously considered, was 8,399,000 cords. Fifty-five percent of the increment was hardwood, but growth of the loblolly and shortleaf pines made up 30 percent of the total increase (table 18).

TABLE 18.—*Net increment of all sound trees 5.0 inches d. b. h. and larger, by species group and province, 1945*

Species group	Coastal Plain	Piedmont	Mountain	State
	M cords	*M cords*	*M cords*	*M cords*
Softwoods:				
Virginia pine	203	859	104	1,166
Other yellow pines	1,647	757	88	2,492
Other softwoods	19	49	83	151
Total	1,869	1,665	275	3,809
Hardwoods:				
Oaks	472	873	594	1,939
Gums and yellow-poplar	631	670	157	1,458
Other hardwoods	262	483	448	1,193
Total	1,365	2,026	1,199	4,590
All species	3,234	3,691	1,474	8,399

Net Increment per Acre

In saw-timber stands, increment per acre in the loblolly pine type in the Coastal Plain (321 board feet) exceeds that in any other type or province (table 19). Its nearest competitor is the cypress-cedar type in the same province, with 272 board feet, followed by the loblolly pine type in the Piedmont (262 board feet). It will be noted that increment in individual types is invariably greater in the Coastal Plain than in the Piedmont, and greater in the Piedmont than in the mountains. For all types averaged, the ratio is very nearly 3 : 2 : 1. The average increment per acre for all commercial forest lands in the State was 121 board feet.

TABLE 19.—*Current annual net increment per acre by forest type, condition, and province, 1940* [1]

Forest type	Coastal Plain		Piedmont		Mountain	
	Saw-timber stands	Cord-wood stands [2]	Saw-timber stands	Cord-wood stands [2]	Saw-timber stands	Cord-wood stands [2]
	Bd. ft.	*Cords*	*Bd. ft.*	*Cords*	*Bd. ft.*	*Cords*
Loblolly pine	321	0.64	262	0.38		
Shortleaf pine	197	.80	176	.60	53	0.17
Virginia pine	190	.73	182	.56	108	.29
Cypress-cedar	272					
Upland hardwoods	166	.64	145	.44	78	.26
Bottom-land hardwoods	251	.38	183	.52		
Cove hardwoods			240	.80	120	.50
White pine					121	.40
All types	263	.62	168	.51	84	.28

[1] Increment in cords includes wood and bark.
[2] Includes stands classed as reproduction.

Under-sawlog-size stands are also reasonably productive. In the Coastal Plain, net increment per acre ranged from 0.8 cord of wood and bark in the short-

leaf pine type to a little less than 0.4 cord in the bottom-land hardwood type, averaging 0.6 cord for all types. Increment rates in the Piedmont had the same gross range but averaged only 0.5 cord. In the Mountain unit growth was much slower, ranging from only 0.17 cord in the shortleaf pine type to 0.5 cord in the cove hardwoods. For all types it was 0.28 cord per acre.

Because the average forest acre is adding 121 board feet of net growth per year, it does not mean that this volume is at once available for conversion into lumber or other products. It must be remembered that this increment includes the recruited volume, i. e., the volume of all trees that each year grew to saw-timber size. For the State as a whole, more than one-half of the net board-foot increment of saw timber comes from recruited volume. In the Piedmont 62 percent of the saw-timber increment is from recruited volume, in the mountains 56 percent, and in the Coastal Plain 45 percent. Thus a very considerable portion of the total volume of wood added each year is on the very smallest trees. These trees must be protected against fire, insects, disease, and other causes of mortality, and against premature cutting, in order to augment the already depleted growing stock. If this is not done, increment will steadily decline, and so will the future growing stock and the future output of forest products. On the other hand, if the stands were well stocked and had a reasonably good distribution of volume among age classes, most of the annual increment in saw-timber volume would be on the larger trees where it could be utilized more effectively.

Commodity Drain

Saw-Timber Drain

Drain upon saw-timber trees in 1945 totaled 1,223 million board feet, of which 719 million feet was softwoods and 504 million feet was hardwoods (table 20). Loblolly and shortleaf pines together provided nearly one-half of the total cut. Oaks were the principal hardwoods cut, followed by gums and yellow-poplar. Forty-three percent of the drain came from the Coastal Plain, 37 percent from the Piedmont, and 20 percent from the mountains. Of the total saw-timber drain, lumber comprised 75 percent, pulpwood 11 percent, fuel wood 6 percent, and other products the remaining 8 percent.

Drain in Cords

The drain from all trees 5.0 inches d. b. h. and larger in 1945 amounted to 4,724,200 cords. Softwoods made up 2,567,300 cords, with loblolly and shortleaf pines comprising two-fifths of the total drain. Oaks provided a little more than one-fourth, and gums and yellow-poplar one-tenth of the total cut (table 21). Lumber was, of course, the principal use, comprising nearly 57 percent of all drain, fuel wood 18 percent, and pulpwood 15 percent. Although softwood growing stock in cords, as of January 1, 1945, comprised only 39 percent of the total volume, it was the source of more than half the cord drain. The pines, chiefly, loblolly and shortleaf, are under heavy cutting pressure since they provide about one-half of the material used for lumber, and four-fifths of the

TABLE 20.—*Commodity drain on saw timber, by product and species group, 1945*

Product	Species group						Total	
	Virginia pine	Other yellow pines [1]	Other softwoods [2]	Oaks	Gums and yellow-poplar	Other hardwoods [3]		
	M bd. ft.	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*Percent*
Lumber	65, 300	378, 200	55, 900	263, 900	105, 700	48, 600	917, 600	75.0
Veneer		900	100	1, 400	16, 700	2, 600	21, 700	1.8
Cooperage	1, 000	17, 200		900	600	100	19, 800	1.6
Pulpwood	29, 100	91, 100		5, 600	6, 800	4, 400	137, 000	11.2
Excelsior	400	4, 800					5, 200	.4
Other manufactures		100	300	700		2, 700	3, 800	.3
Mine timbers	200	3, 700	100	2, 400	500	2, 900	9, 800	.8
Hewn cross ties		100		12, 500			12, 600	1.0
Poles and piles	100	16, 300		200	600	300	17, 500	1.5
Fuel wood	14, 500	36, 200		15, 200	3, 000	2, 700	71, 600	5.9
Fence posts		100	3, 300	2, 000		900	6, 300	.5
Total	110, 600	548, 700	59, 700	304, 800	133, 900	65, 200	1, 222, 900	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		
	9.0	44.9	4.9	24.9	11.0	5.3		100.0

[1] Loblolly and shortleaf pines chiefly. [2] White pine, hemlock, redcedar, white-cedar chiefly. [3] Chestnut is not included.

TABLE 21.—*Commodity drain on all sound trees 5.0 in ches d. b. h. and larger, by product and species group, 1945* [1]

Product	Species group						Total	
	Virginia pine	Other yellow pines	Other softwoods	Oaks	Gums and yellow-poplar	Other hardwoods		
	Cords	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Percent*
Lumber	216, 000	1, 089, 500	140, 900	794, 600	298, 000	141, 900	2, 680, 900	56. 8
Veneer		2, 500	200	3, 800	42, 800	7, 300	56, 400	1. 2
Cooperage	3, 800	64, 500		2, 400	4, 200	300	75, 200	1. 6
Pulpwood	158, 000	432, 500		38, 600	62, 300	31, 900	723, 300	15. 3
Excelsior	2, 500	27, 500					30, 000	. 6
Other manufactures	100	200	1, 000	2, 500	100	13, 100	17, 000	. 4
Mine timbers	1, 200	25, 700	300	37, 000	16, 300	43, 500	124, 000	2. 6
Hewn cross ties		400	100	48, 300	100		48, 900	1. 0
Poles and piles	400	48, 100	100	900	1, 500	900	51, 900	1. 1
Fuel wood	128, 100	200, 600		333, 500	80, 400	84, 900	827, 500	17. 5
Fence posts	400	700	22, 200	14, 200	200	51, 400	89, 100	1. 9
Total	510, 500	1, 892, 000	164, 800	1, 275, 800	505, 900	375, 200	4, 724, 200	
	Percent 10. 8	*Percent* 40. 1	*Percent* 3. 5	*Percent* 27. 0	*Percent* 10. 7	*Percent* 7. 9		100. 0

[1] Chestnut is not included.

pulpwood. Only a few products—fuel wood, veneer, mine timbers, hewn cross ties, fence posts, and "miscellaneous" items—exert a heavier drain on hardwoods than on softwoods. Except for fuel wood, all these products together account for only 7 percent of total cord drain. Fuel wood is about 60 percent from hardwood species. An opportunity exists for increasing the pine growing stock by still greater use of hardwoods for fuel wood, especially where there is an abundance of poor-quality trees.

The distribution of total commodity drain by tree-diameter classes and species groups reveals that 55 percent of the softwood drain comes from trees less than 13 inches, but less than 14 percent comes from trees over 19 inches in diameter (table 22). This distribution of drain is another indication of the extent to which today's softwood drain is coming out of tomorrow's growing stock.

Comparison of Forest Increment and Drain, 1940–45

The relation between net increment and commodity drain cannot be regarded as a reliable index of the forest situation in a region or State unless data are available for a considerable period of time, and unless the operation of economic factors in the future can be predicted with accuracy. This is particularly true of a State such as Virginia where forest industries are geared to the utilization of small as well as large timber, and where a great variety of species are used for an increasingly large number of purposes. Furthermore, increased fire protection, better management practices, better and more mechanized manufacture of products, epidemics of insects or diseases, and hardwood invasion are some of the current or prospective changes that may materially affect growing stock, growth rates, and commodity drain.

Several other points must be kept in mind in this connection. A few years in which drain exceeds growth, even to a considerable degree, can be counterbalanced by a period in which there is a surplus of growth. For example, annual lumber production in Virginia has averaged 1 billion board feet for the past 40 years. The production level of the first 10 years could not have been maintained indefinitely and only because of a decided decline in lumber output during the second and third decades did the growing stock become sufficiently augmented so that a gradually increasing production during the fourth decade has been possible. This emphasizes that a few years of high growth deficit does not necessarily mean irreparable damage to the forest stands.

TABLE 22.—*Distribution of commodity drain in cords by tree diameter and species group, average year*

Diameter class (inches)	Softwoods		Hardwoods		Total	
	M cords	Percent	M cords	Percent	M cords	Percent
6–8	477	15. 3	350	17. 3	827	16. 1
10–12	1, 228	39. 5	548	27. 1	1, 776	34. 6
14–18	989	31. 8	637	31. 5	1, 626	31. 7
20+	416	13. 4	486	24. 1	902	17. 6
Total	3, 110	100. 0	2, 021	100. 0	5, 131	100. 0

A second point to consider is that the Survey data are for provinces of several million acres and therefore may not reflect accurately conditions in smaller specific areas. When data are grouped into State tables, the figures may be even more misleading because gross deficits in one section may be masked by surpluses in another. Nevertheless, the data here presented do indicate the trends in the relation of growth to drain during the 6-year period since the original survey for both the State and its provinces.

Saw-Timber Balance

The net change in growing stock over the 6-year period (January 1, 1940, to January 1, 1946) is summarized in table 23. In using these data the reader is cautioned against considering the values as precise measurements of change. The original 1940 inventory was considered accurate, but annual changes since then have been based upon the difference between computed growth and measured drain. This provides only a reasonably reliable indication of trends in the volume of growing stock.

The over-all figures for the State are encouraging and point up the high productive powers of Virginia's forests, for, in spite of heavy cutting to meet war demands, 1,738 million board feet of saw timber were added to the growing stock. This is a net "earning" of 7 percent on the 1940 "capital" of growing stock (fig. 63).

Less reassuring are some of the details of this increase. Although the softwoods showed little change in total volume, there was a serious reduction in shortleaf saw timber in the Piedmont. Cypress and white-

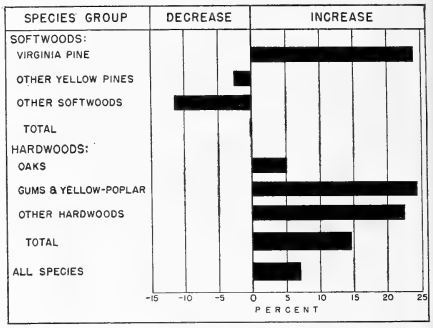

FIGURE 63.—*Net change in saw-timber growing stock, 1940 to 1946.*

TABLE 23.—*Net change in saw-timber growing stock, Jan. 1, 1940, to Jan. 1, 1946*

Item	Softwoods				Hardwoods				All species
	Virginia pine	Other yellow pines	Other soft-woods	Total soft-woods	Oaks	Gums and yellow-poplar	Other hardwoods	Total hard-woods	
	Million bd. ft.	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*
Growing stock, Jan. 1, 1940:									
Coastal Plain	352	7,289	278	7,919	1,013	1,956	860	3,829	11,748
Piedmont	1,034	1,984	116	3,134	2,341	1,289	735	4,365	7,499
Mountain	123	504	586	1,213	2,529	458	749	3,736	4,949
Total	1,509	9,777	980	12,266	5,883	3,703	2,344	11,930	24,196
Growing stock, Jan. 1, 1946:									
Coastal Plain	347	7,462	219	8,028	1,136	2,362	1,059	4,557	12,585
Piedmont	1,361	1,534	111	3,006	2,645	1,725	977	5,347	8,353
Mountain	163	522	538	1,223	2,410	524	839	3,773	4,996
Total	1,871	9,518	868	12,257	6,191	4,611	2,875	13,677	25,934
Net change, Jan. 1, 1940, to Jan. 1, 1946:									
Coastal Plain	−5	+173	−59	+109	+123	+406	+199	+728	+837
Piedmont	+327	−450	−5	−128	+304	+436	+242	+982	+854
Mountain	+40	+18	−48	+10	−119	+66	+90	+37	+47
Total	+362	−259	−112	−9	+308	+908	+531	+1,747	+1,738
Percentage change, Jan. 1, 1940, to Jan. 1, 1946:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Coastal Plain	−1.4	+2.4	−21.2	+1.4	+12.1	+20.8	+23.1	+19.0	+7.1
Piedmont	+31.6	−22.7	−4.3	−4.1	+13.0	+33.8	+32.9	+22.5	+11.4
Mountain	+32.5	+3.6	−8.2	+.8	−4.7	+14.4	+12.0	+1.0	+.9
All provinces	+24.0	−2.6	−11.4	−.1	+5.2	+24.5	+22.7	+14.6	+7.2

cedar in the Coastal Plain, redcedar in the Piedmont, and white pine and hemlock in the mountains were also cut too heavily. An increase in loblolly pine in the Coastal Plain partially compensated for these losses, but the bulk of the deficit was made up by the substantial increase in Virginia pine saw timber in the Piedmont. This is far from a fair exchange as Virginia pine is much lower quality saw timber than shortleaf pine. The effect has been to lower the average quality of the softwood saw timber, particularly in the Piedmont, and to make no gain in the total amount of saw timber.

Hardwood saw timber appeared to increase markedly during the 6-year period, particularly in the Coastal Plain and Piedmont. The only indicated decrease was in the "oaks" in the mountains, where over one-half of the lumber is cut from these species. Here, a rather large sawmill population has difficulty finding suitable operable timber. Many observations of sawmill operations, supplemented by monthly records of lumber production, indicate that yellow-poplar in the Piedmont was also subject to heavy cutting during the war years. The magnitude of this cut cannot be obtained from table 23, but it is safe to say that the hardwood stands of the Piedmont now contain relatively less good-quality yellow-poplar and more poor-quality gum and oak than before the war.

Balance in Cords

The growing stock of all sound trees 5.0 inches d. b. h. and larger, measured in cords, increased about 11 percent during the 6-year period (table 24). More favorable growth-drain ratios in the under-sawlog-size softwoods resulted in a small increase in the total volume of softwood. Loblolly and Virginia pines increased in the Coastal Plain, but shortleaf pine in the Piedmont suffered an indicated loss of nearly one million cords. The greatest apparent increase in the softwoods was in the Virginia pine of the Piedmont.

The increase of hardwoods was nearly four times that of the softwoods, partly because of a larger volume of growing stock but also because of the limited amount of cutting in hardwoods of less than saw-timber size. The net increase was about 15 percent, with all three species groups showing an appreciable increase (fig. 64).

Trends in Composition of Growing Stock

During the war years the proportion of softwood in total commodity drain decreased from its peak in 1941.

TABLE 24.—*Net change in total growing stock,*[1] *Jan. 1, 1940, to Jan. 1, 1946*

Item	Softwoods				Hardwoods				All species
	Virginia pine	Other yellow pines	Other softwoods	Total softwoods	Oaks	Gums and yellow-poplar	Other hardwoods	Total hardwoods	
Growing stock, Jan. 1, 1940:	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*	*M cords*
Coastal Plain	2,340	29,846	823	33,009	9,153	12,012	5,848	27,013	60,022
Piedmont	7,725	13,209	577	21,511	19,031	9,118	7,196	35,345	56,856
Mountain	1,030	2,661	1,915	5,606	14,620	2,397	6,261	23,278	28,884
Total	11,095	45,716	3,315	60,126	42,804	23,527	19,305	85,636	145,762
Growing stock, Jan. 1, 1946:									
Coastal Plain	2,506	31,252	676	34,434	10,128	14,423	6,972	31,523	65,957
Piedmont	10,105	12,285	664	23,054	20,885	11,463	9,144	41,492	64,546
Mountain	1,342	2,656	1,932	5,930	15,257	2,654	7,694	25,605	31,535
Total	13,953	46,193	3,272	63,418	46,270	28,540	23,810	98,620	162,038
Net change, Jan. 1, 1940, to Jan. 1, 1946:									
Coastal Plain	+166	+1,406	−147	+1,425	+975	+2,411	+1,124	+4,510	+5,935
Piedmont	+2,380	−924	+87	+1,543	+1,854	+2,345	+1,948	+6,147	+7,690
Mountain	+312	−5	+17	+324	+637	+257	+1,433	+2,327	+2,651
Total	+2,858	+477	−43	+3,292	+3,466	+5,013	+4,505	+12,984	+16,276
Percentage change, Jan. 1, 1940, to Jan. 1, 1946:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Coastal Plain	+7.1	+4.7	−17.9	+4.3	+10.7	+20.1	+19.2	+16.7	+9.9
Piedmont	+30.8	−7.0	+15.1	+7.2	+9.7	+25.7	+27.1	+17.4	+13.5
Mountain	+30.3	−.2	+.9	+5.8	+4.4	+10.7	+22.9	+10.0	+9.2
All provinces	+25.8	+1.0	−1.3	+5.5	+8.1	+21.3	+23.3	+15.2	+11.2

[1] All sound trees 5.0 inches d. b. h. and larger.

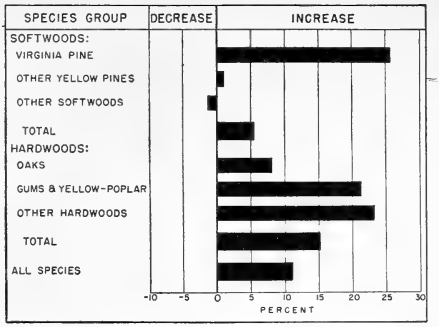

FIGURE 64.—*Net change in total growing stock, measured in cords, 1940 to 1946.*

In that year, 70 percent of the saw-timber drain, and 63 percent of the drain of all material, was softwood. By 1945 the proportion of softwood in the drain had declined to 59 percent of saw timber and 54 percent of all material (fig. 65). The principal reason for this decline lay in the greatly increased demand for hardwood for war needs subsequent to the outbreak of hostilities. Some of it may well have been the result of diminishing supplies of operable softwood timber.

Whatever the causes, this proportional decline in softwood drain relieved for a few years some of the pressure on the softwood growing stock. As has been noted, however, the softwood growing stock continued to decline in relation to the total stand (fig. 65), and there is every reason to expect that the proportion of softwood in the drain will rise again. In 1946, hardwood demand slackened as war contracts were canceled. At the same time, the pent-up demand for construction lumber and increased consumption of pulpwood accelerated softwood drain. While softwoods may not again reach the 1941 peak of 70 percent of all saw-timber drain, there is little question but that they will rise above the 1945 level over the next decade, and that a very large proportion of softwood drain will be loblolly and shortleaf pines. Saw-timber growth of these species now barely exceeds drain in the Coastal Plain. In the Piedmont additional drain would further accentuate the decline in shortleaf saw timber, which appears to have decreased nearly one-fourth in 6 years.

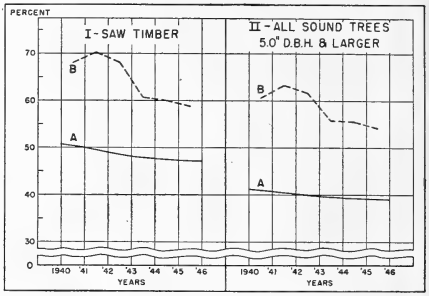

FIGURE 65.—*A, Proportion of growing stock which was softwood, as of January 1 each year; and B, proportion of commodity drain which was softwood in each year (plotted over midpoint of year).*

To be sure, better protection of forests from fire, insects, and disease, better utilization practices in both woods and mill, changed demands arising through technological advances—all of these can change the picture quite radically, and undoubtedly will do so in time. Nevertheless, in certain parts of the State, notably the Piedmont, the industries now cutting pine may be forced in a relatively short time to adapt their output increasingly toward a hardwood market. In view of the currently readier markets for pine, its quicker growth, higher yield, and lower cost of harvesting, such a transition to a predominately hardwood operation may well require a major adjustment in the industrial economy of the Piedmont.

Opportunities for Increasing the Utility of the Timber Resources

VIRGINIA'S opportunity for permanently maintaining a valuable forest industry, and even expanding it, lies in extensive forest lands whose potentialities are at present unrealized. These potentialities can be realized by growing more of the material industry needs instead of cutting that material so heavily that less good-quality timber remains each year to reproduce itself.

Assets

The great and essential asset is 14.4 million acres of commercial forest land. With such land, the State can produce adequate timber supplies for its wood-using industries, provided the land is managed well. The forest has high productive powers, as evidenced by the excess of growth over drain during the heavy cutting of the war years, even though much of that excess growth was in less valuable species. The State has an enviable fire control record, and all forest land is now under organized protection. The Federal-State program of assistance to timber owners in estimating and marking timber for cutting, and in sound management, utilization, and marketing, has recently been materially expanded. Among other important assets the State has extensive and diversified forest industries which furnish the demand for timber products. As these industries feel the pinch of saw-timber shortage, they are backing forestry programs more and more actively each year.

Liabilities

On the 14.4-million-acre forest area the stands are so depleted and understocked they grow only one-third to one-half what they could. On 3,400,000 acres, nearly one-half of the State's saw-timber area, the stands average less than 1,200 board feet per acre, and hence can be logged only by small "ground" mills turning out rough, green, and often poorly sawed lumber. These mills commonly cut and saw too many small trees. In one-fourth of the counties in the State, the average stand per acre of commercial forest land is only 830 board feet. One-half of the forest area of Virginia does not have enough timber to meet even the low minimum requirements for saw timber.

Also, 15 percent (29 million cords) of the total sound wood volume is in cull trees. Ninety percent of that volume is hardwood, chiefly oaks, hickories, and scrub species. On the basis of area required for an equal volume of sound trees, these culls occupy 2 million acres of productive forest land. That area represents 14 percent of Virginia's commercial forest land.

In addition, too large a part of the total wood volume is in the smaller trees. From 55 to 82 percent of the sound volume in cords of the four most valuable and abundant species, and two-thirds of the volume of all species, is in trees less than 13 inches d. b. h. Such trees do not yield high-quality saw timber, but it is common practice to saw them into lumber.

Plan of Action

There are a number of ways of decreasing liabilities and increasing assets. It is a matter of changing a steadily deteriorating situation to a steadily improving one.

Increase Volume

The most certain method of building up stand volume is to reduce the cut below the net growth of the forest under sound practices of forest management. This practice works well on managed forests under stable ownership, but in a State with nearly 13 million acres of private forest land held by thousands of owners, such a prescription is difficult to follow. In spite of this, there are certain parts of the State, in certain forest types, where the cut will have to be

reduced, either deliberately or through force of circumstances. Such areas include particularly the shortleaf pine type in the Piedmont and the white pine type in the mountains. If the cut in these stands is not held below growth, the industries dependent on saw timber from such areas eventually will face an acute shortage of raw material.

Fortunately, a more positive approach is justified for the rest of the types, which include those most important commercially. Instead of trying to reduce the cut, emphasis should be placed on increasing the growing stock while keeping the cut at present levels until additional yields warrant increasing it. Basic in the approach to this task are adequate fire control, protection of reproduction and young saplings from logging damage, and an expanded planting program on abandoned fields, on clear-cut areas where follow-up release is planned, and in poorly stocked old-field pine stands. A greater percentage of merchantable but immature trees must be reserved from cutting.

Improve Quality

Improvement cuttings to eliminate low-value trees and to improve the composition of the stand are particularly necessary where undesirable hardwoods are encroaching on pine lands. Improvement cuts can be profitable if markets are available for the material removed, or if, as on farms, the material can be used by the owner. Mine timbers in the mountains, pulpwood and low-grade lumber in the Coastal Plain and the Piedmont, and fuel wood in all provinces are salable products from improvement cuts. If there are no markets, the cuts involve a financial outlay, to be regarded in the same light as the cost of fire protection, planting, or other maintenance costs.

Thinning, which is another important method of improving timber quality, can often be made to pay for itself, too. In fact, thinnings sold as pulpwood or fuel wood frequently bring higher returns than the sale of improvement cuttings. Frequent thinning of stands being managed for saw timber or other high-quality products is beneficial but tends to encourage the encroachment and development of brushy hardwoods. Thinning of pine stands being managed primarily for pulpwood is less profitable where it aggravates the hardwood-control problem. Sometimes old-field stands of Virginia, shortleaf, or loblolly pine are so densely stocked that they tend to stagnate unless thinned early. When the stands are thinned, however, the trees respond vigorously. Pruning of pine will probably be done mostly in farm or other small woodlands, but industrial timberland owners may also find it profitable in producing higher grade logs.

These practices, plus harvest cutting designed to improve stand quality, have been advocated by foresters for the past decade or more. Yet a field survey made in 1945 showed that forest practices on half the smaller holdings and on two-fifths of the larger holdings are still not up to a standard sufficient to maintain forest productivity and that the stands on such holdings are deteriorating.

Better Protection

Good as the fire control record is, it can be materially improved—at a price. Virginia has no alternative but to pay the price if she wants to keep her forests green. The total cost, from Federal, State, county, and private sources, for full protection of State and private forest lands adequate to hold annual fire loss to less than 0.4 percent of area protected is estimated to be $715,000 per year, more than three times the 1945 budget.

While losses from insects and disease are not as spectacular and visible as losses from fire, in the long run they are frequently more costly. Witness the chestnut blight, and the ravages of the southern pine beetle. It has not been possible to control some diseases, such as the chestnut blight, with any means now available to science. However, the losses from many other diseases, such as fusiform rust of southern pines and the heart rots, can be greatly reduced through practical measures already developed.

Improve Timber Utilization

Efficient use of what already grows can make the forest considerably more valuable. Pines are overcut, which leaves openings that are all too often filled by hardwoods. Thus, many pure pine stands are converted into mixed pine-hardwood or pure hardwood stands, generally of low quality. Profitable uses are being found for the low-grade hardwoods, but many more wood-products plants are needed to cut and use this plentiful material. The abundant supply of low-grade hardwoods presents a rather favorable opportunity for such operations. In 1945 there were but 23 plants in Virginia turning out handle blanks, picker sticks, insulator pins, mine wedges, shuttle blocks, wooden utensils, small-dimension stock, and similar minor products. In all they utilized only 30,900 cords of wood. This is a small fraction of the volume that could be removed with benefit to the forest—provided

new plants utilize low-grade hardwoods and do not specialize in the high-grade hardwoods, which are being cut almost as heavily as the pines. Among the products which could be increasingly produced are furniture, sports equipment, toys, woodenware, spools, toothpicks, buttons, dowels, shade and map rollers, boot and shoe findings, mine wedges, and novelties.

That a concentrated cut is at present depleting the best grades and sizes in the more desirable species of hardwoods points to the necessity of greater use of poor-quality material. One-fifth (26 million cords) of the total hardwood volume in trees 5 inches d. b. h. and over is cull, and an additional large volume is in such species of limited merchantability as scarlet, post, and water oaks, elms, sycamore, and hickory. Failure to use a greater proportion of this large volume of wood is not only a waste of raw material but also poor forest management. Timber operators cannot be expected to cut and process species or grades which they cannot sell, or can sell only at a loss. Greater utilization, therefore, depends on finding profitable markets for this material.

For example, there is an opportunity for using a much larger volume of cull material and hardwood tops and limbs for fuel wood throughout the State, thereby reducing the volume of sound saw timber used for this purpose. In the period 1940–45 the average annual hardwood saw-timber drain going into fuel wood was 25.9 million board feet. None of this volume came from cull trees or from top wood of sound trees; all of it was from sound saw-timber growing stock, mostly oak. Some of it, no doubt, came from oaks and other species not presently in heavy demand, but most of it was material readily merchantable as sawlogs. There are better uses for this 26 million feet of hardwood saw timber than using it for fuel wood, so long as overabundant quantities of suitable material are available from cull trees, top wood, and mill waste.

Most of the 2.5 million cords of cull blackgum and tupelo is suitable for pulp and is entering increasingly into this product. With the increased pulping of hardwoods now under way, this industry can materially aid in utilizing previously unmerchantable species and grades, at least of gums, soft maple, yellow-poplar, some of the oaks, and other pulping species.

The people in the mountains commonly use poor-quality oaks and other hardwoods for rough construction lumber for houses and farm buildings. The buildings so constructed are satisfactory, indicating the desirability of a greater use of similar material in the Piedmont and Coastal Plain to help reduce the present heavy cut of pine and the surplus of poor-quality hardwoods. Other possibilities in this field include the popularizing of now unwanted but satisfactory species by the manufacturers of furniture, novelties, and other minor products.

Standardized Log Grades

The current practices of buying stumpage on a lump-sum basis, i. e., so much for the tract, and of buying logs at the mill on a log-run basis are a deterrent to good forest management. Even where logs are sold on grade, the grades commonly differ at each mill. Consequently, logs are rarely sold at a price based on grade yields of lumber. Both timber owners and timber operators suffer from these practices, since the owner almost inevitably gets a lower price for his stumpage and the operator cannot specify the logs suitable to his particular products or type of operation. The development and use of standard log grades for pine and for hardwoods would solve both difficulties and would be an incentive toward better cutting practices.

Ways to Accomplish Needed Improvements

To meet the needs of the forest, simultaneous efforts by all organizations and individuals—local, State, Federal, and private—offer the best chance for fundamental improvement. Among the large number of possible actions are numerous aids and services to private owners, expansion and intensified management of public forests, and public control of cutting and other forest practices on private land.

One essential to getting good forest practices in effect is a full-scale, State-wide education program in the woods, with on-the-ground technical assistance to timber owners. People must be told and shown again and again that timber stand improvement, thinning, and sustained-yield cutting pay short-term and long-term dividends. They have to learn that, with present-day heavy use, the days when the forest took care of itself are over. They must be taught common-sense methods of timber stand improvement, thinning, and harvest cutting so that how to do it and when to do it are common knowledge. To be effective, this educational campaign has to be aimed directly at the 174,000 small forest owners who control approximately 80 percent of Virginia's woodlands. Personal contacts with so large a number of individuals are difficult and costly, but these are the key people. Two-thirds of their land is unmanaged and poorly or destructively cut.

For the industrial timber owners and larger individual owners, practical advice and assistance on timber estimating, cutting methods, log grading, timber values, and market opportunities can usually be obtained from company or private consulting foresters. For the farmer and for the small nonfarm owner advice and assistance will need to come largely from publicly employed foresters. While both the Federal and State Forest Services now provide some assistance to farmers (as well as limited amounts to larger owners), there is great need for immediate expansion of effort if any but a small fraction of Virginia's timber owners are to be reached. A forester in each heavily timbered county and one in each small group of less heavily forested counties is highly desirable. Virginia has recently expanded its efforts in this field in cooperation with the Federal Norris-Doxey Act program, but these efforts are still far from the requirements just described, even though the Virginia Forest Service is moving toward this goal as rapidly as available funds permit.

Forest-products cooperative marketing associations offer perhaps another opportunity for improved forest practices. While forest-products cooperatives are relatively untried and while they have many pitfalls, a well-managed and honestly run association, with requirements for forest management by its members, offers protection to both buyer and seller against inequitable prices, gives the buyer prior knowledge of quantity and quality of timber available, permits purchase from one source, and provides the seller with a definite market at established prices.

Funds for protection against fire, insects, and disease have not been adequate. They should be materially increased.

For the most part, private enterprise should own and operate the forest land now in its hands, where such land can be managed so as to be kept reasonably productive. But where private owners are unable or unwilling to maintain productivity, there is need for public ownership. Such public ownership should be distributed through all levels of government—Federal, State, county, and municipal.

Greatly expanded research is needed in the fields of silviculture, management, utilization and products, and economics to make available sound information on forest use and development to all timber owners and forest administrators. Equally necessary, of course, is research on phases of forestry not covered in this report—watershed management, wildlife management, recreation development, and others. Intensive research along the broad lines suggested will provide the basic information requisite to a great improvement in timber management and utilization.

Responsibility for publicly financed research in Virginia rests mainly with the Virginia Forest Service, the Agricultural Experiment Station of Virginia Polytechnic Institute, and the Southeastern Forest Experiment Station of the Forest Service, United States Department of Agriculture. Forest research is also carried on to a limited extent by some of the larger corporations and by conservation and trade associations.

Forest research takes time, however, and known measures to increase the utility of the forest should not be delayed. With existing knowledge there are many opportunities to improve forest practices, growing stock, protection, and timber utilization. These opportunities can be realized through the active cooperation of all timber owners and timber operators, both individual and corporate, and public agencies at all levels of government. By such cooperation, Virginia's forest resource can continue to provide not only the raw materials which make her forest industry possible, but jobs for thousands of additional workers, profits for the owners of both the stumpage and the processing plants, and products for all the people of Virginia.

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Appendix

Survey Methods

Field Inventory

The field inventory of the timber resources of Virginia was made in 1940. To facilitate analysis and use of the data, the State was divided into five survey units, varying in size from 4.3 million acres to 6.4 million acres, namely, the Coastal Plain; the northern Piedmont, the southern Piedmont (combined in this report); the northern mountains, and the southern mountains (combined in this report).

In the field survey, crews gridironed the State with compass lines spaced 10 miles apart. At intervals of one-eighth mile along each line, one-fourth-acre sample plots were established. Records obtained on 31,390 plots form the basis for computing the areas devoted to various kinds of land use. Of these, 18,087 were forest plots, and here detailed measurements and observations were made concerning the number, size, and species of trees, the forest type and stand conditions, degree of fire damage, density and distribution of reproduction, growth, and site quality. Data for construction of volume tables were collected by supplementary sampling by J. W. Girard, of the Forest Service, who also determined timber-cull percentages.

In estimating forest area there were two possible sources of error: (1) errors in classifying field plots or in compiling the data, and (2) sampling errors. The first arise from mistakes of judgment or technic and were minimized by the exercise of care and skill, even though it was seldom possible to evaluate them. In the Survey of Virginia, every effort was made to maintain a high order of accuracy in the collection and compilation of data. In the field this took the form of frequent checks and a continuous program of training. In the office the work was organized to permit automatic machine verification of the more important operations.

The sampling method used did not permit computation of sampling errors of the area estimates under correct statistical procedures. However, comparisons of forest area obtained by the Forest Survey plot method of sampling with the same forest area planimetered from aerial photographs indicated that the plot method of sampling gave results within 2 percent of the planimetered area for forested areas as small as 1.5 million acres. These empirical checks indicate that the Forest Survey estimate of the forest area of Virginia should be rather precise and that estimates for the three major physiographic regions of the State were also reliable.

In estimating timber volumes, the possible sources of error included (1) and (2) above and, in addition, (3) inaccurate measurements of tree diameter, height, or cull, and (4) bias resulting from improper construction, selection, or use of tree volume tables. As in the case of forest area determinations, every effort was made to obtain accurate measurements through frequent checks and training. The volume tables used also were checked and were found to give reasonably accurate results. It was not possible to compute sampling errors of the volume estimates, but on the basis of subsequent experience with random samples of roughly comparable intensity and the computation of sampling errors, it seems safe to assume that the error of the estimated saw-timber volume in the State does not exceed ± 2.5 percent.

The reliability of one statistic as compared to another presented in the same or a related table can be judged roughly by its relative magnitude. In general, the larger values warrant greater confidence, while the smallest should be considered indicative rather than as absolute quantities.

Increment

Measurements for growth calculations were obtained from increment borings made in a mechanically selected sample of all trees over 3 inches in diameter. In general, computational procedures consisted of determining the volume of small trees that grew to merchantable size during the period and of increasing the sample tree diameters by the measured diameter growth of the preceding decade. The differences be-

tween present and projected volume of the sample trees was then expressed as a percentage increase and applied directly to the inventory volume.

Drain

Data on forest industries and estimates of commodity drain for 1940 were based upon an intensive field canvass of primary forest-products plants and domestic wood consumers. Since 1940 the Forest Service has cooperated with the Bureau of the Census, and since 1942 also with the War Production Board and its successor, the Civilian Production Administration, to obtain data on production of lumber and other forest products and related wood-products statistics.

Computations

Compilation of the inventory and growth data was accomplished through the use of punch cards. The machine tabulations obtained from the punch cards could be used directly in the preparation of the final tables. The flexibility, uniformity, and economy of this method made possible the rapid, precise compilation of a large volume of data at reasonable cost.

Definitions of Terms Used

The technical and uncommon terms used in this report, as well as certain common terms given special meaning, are defined as follows:

Land Use Classes

Commercial forest—Forest land having qualities essential to the production of merchantable timber.

Public reserved forest—Forest land in Federal and State ownership upon which commercial timber cutting is prohibited.

Noncommercial forest—Forest land too poor in quality to produce merchantable timber in a reasonable time.

Cropland—Nonforest land used for production of farm crops within the last 5 years.

Abandoned cropland—Land once cultivated, now definitely abandoned for farm crops and not being used for pasture. No forest cover present.

Pasture—Cleared, fenced lands that are used primarily for grazing.

Marsh—Low, boggy, nonforested areas bordering water bodies and streams, where drainage is too poor to permit agricultural use.

Other nonforest—Includes areas within the corporate limits and suburban or industrial sections of towns and cities; power, rail, and highway rights-of-way; sand dunes, beaches, water areas, and other miscellaneous nonforest land.

Forest Types

Loblolly pine—Stands in which softwoods form 25 percent or more of the dominant and codominant trees, with loblolly pine predominating. Includes pond pine in the Coastal Plain.

Shortleaf pine—Stands in which softwoods form 25 percent or more of the dominant and codominant trees, with shortleaf pine predominating. Redcedar is included here, although it forms a distinct type over limited areas.

Virginia pine—Stands in which softwoods form 25 percent or more of the dominant and codominant trees, with Virginia pine predominating.

White pine—Stands in which softwoods form 25 percent or more of the dominant and codominant trees, with white pine predominating.

Bottom-land hardwoods—Stands of mixed hardwoods in swamps and along streams, with hardwood species forming 75 percent or more of the dominant and codominant trees. Includes cypress and white-cedar in the Coastal Plain.

Cove hardwoods—Stands in which yellow-poplar, cucumbertree, red maple, white ash, river birch, and basswood form 75 percent or more of the dominant and codominant trees; usually found on lower north slopes and in coves along small streams. This type includes stands of northern hardwoods, with sugar maple, beech, and yellow birch making up 75 percent or more of the overstory.

Upland hardwoods—Stands on well-drained, upland sites in which mixed oaks and other hardwoods form 75 percent or more of the dominant and codominant trees.

Diameter Classification

D. b. h. (diameter at breast height)—Diameter in inches, outside bark, measured at 4.5 feet above average ground level.

Diameter class—All trees were recorded in 2-inch diameter classes, each class including diameters 1 inch below and 0.9 inch above the stated midpoint; e. g., trees from 7.0 to and including 8.9 inches are placed in the 8-inch class.

Tree Classes

Sound saw-timber tree—A softwood tree at least 9 inches d. b. h., or a hardwood tree at least 13 inches d. b. h., with not less than one sound butt log 12 feet long, or with at least 50 percent of the gross volume of the tree in sound saw timber.

Sound under-sawlog-size tree—Any straight-boled tree between 1 inch d. b. h. and sawlog size, sound enough to indicate that it could eventually make a sound saw-timber tree as described above. Cord and cubic-foot volumes include trees 5.0 inches d. b. h. and larger.

Cull tree—Any tree that fails to qualify as a sound tree because of poor form, excessive limbiness, rot, or other defect.

Pole tree—A pine tree that will produce a pole conforming to specifications of the American Standards Association.

Forest Conditions

Old-growth timber—Mature or overmature forest growth having characteristics of the original mature timber.

Second-growth timber—Trees that have come up after the removal of the old stand by cutting, fire, or other cause, or young trees left after logging old timber.

Saw-timber stands—Stands containing at least 600 board feet per acre in pine types, and 1,000 board feet in hardwood types.

Cordwood stands—Stands of trees below sawlog size but averaging more than 1 inch d. b. h. which may contain some

saw-timber volume but less than the minimum required for saw-timber stands.

Reproduction—Stands too young to classify as cordwood, but with at least 80 well-distributed seedlings per acre.

Clear-cut—Cut-over areas having insufficient young growth to qualify either as cordwood or reproduction.

Volume Estimates

Board-foot volume—Includes only the saw-timber portion of saw-timber trees. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cord volume—This volume (including bark) includes the following at all times:

1. The sawlog portion of saw-timber trees.
2. The upper stems of saw-timber softwoods to a minimum diameter of 4 inches outside bark.
3. The full stem of cordwood trees at least 5 inches d. b. h. to a variable top diameter of at least 4 inches outside bark.

In certain tables (see footnotes) the following additional wood is included:

1. The sound wood in cull trees.
2. The upper stems and limbs of saw-timber hardwoods and cypress to a minimum diameter of 4 inches outside bark.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Cubic-foot volume—This volume includes the same material as the cord volume excepting the bark.

International ¼-inch rule—This rule was used for obtaining the board-foot volume of logs, and was derived from the formula: $V=(0.22D^2-0.71D)\times 0.905$ for a 4-foot section, where V=volume in board feet and D=diameter in inches at the small end of the section. Taper allowance=½ inch per 4 linear feet.

Standard cord—The equivalent of a stack of round or split wood measuring 4 by 4 by 8 feet. The solid content of wood and bark varies with the diameter and form of the individual pieces; for softwoods it averages about 90 cubic feet, for hardwoods about 80 cubic feet.

Growth and Drain

Growing stock—The sum of the volumes of all sound trees 5 inches d. b. h. and larger. Dead and cull trees and tops and limbs of hardwoods and cypress are not included.

Gross increment—The gross volume of wood produced on the growing stock in a given period—usually one year—without correction for losses by mortality and deterioration.

Mortality—The volume lost from the growing stock by the death or destruction of individual trees through such natural causes as fire, tree competition, insects, disease, and wind.

Net increment—Gross increment minus mortality.

Saw-timber or board-foot increment—The net increment on the saw-timber portion of saw-timber trees, plus the saw-timber volume in sound trees reaching saw-timber size.

Net increment of the total stand—The net increment on all sound trees 5 inches d. b. h. and larger, with the exception of the upper stems and tops of saw-timber hardwoods, plus the sound-tree volume of all trees reaching 5 inches d. b. h. during the increment period.

Commodity drain—The sound-tree growing stock removed from the forest, the sound usable material left in felled tops, and trees destroyed in logging.

Board-foot drain—Commodity drain of sound sawlogs.

Cordwood drain—Commodity drain, measured in cords, from all sound trees 5 inches d. b. h. or larger, except the tops and limbs of hardwoods and cypress. Bark volume is included.

Cubic-foot drain—Identical with cordwood drain, except that bark volume is excluded.

Species	SOFTWOODS	
Lumber or trade name	*Recognized common name*	*Botanical name*
Cedar, red	Eastern redcedar	*Juniperus virginiana.*
Cedar, white	Atlantic white-cedar	*Chamaecyparis thyoides.*
	Northern white-cedar	*Thuja occidentalis.*
Cypress	Baldcypress	*Taxodium distichum.*
	Pondcypress	*T. ascendens.*
Fir, eastern	Fraser fir	*Abies fraseri.*
Hemlock	Eastern hemlock	*Tsuga canadensis.*
	Carolina hemlock	*T. caroliniana.*
Pine, southern yellow	Loblolly pine	*Pinus taeda.*
	Longleaf pine	*P. palustris.*
	Pitch pine	*P. rigida.*
	Pond pine	*P. rigida* var. *serotina.*
	Shortleaf pine	*P. echinata.*
	Table-Mountain pine	*P. pungens.*
	Virginia pine	*P. virginiana.*
Pine, white	Eastern white pine	*P. strobus.*
Spruce, eastern	Red spruce	*Picea rubens.*

Lumber or trade name	*Recognized common name*	*Botanical name*
Ash, mountain	American mountain-ash	*Sorbus americana.*
Ash, white	White ash	*Fraxinus americana.*
	Red ash	*F. pennsylvanica.*
	Green ash	*F. pennsylvanica* var. *lanceolata.*
	Carolina ash	*F. caroliniana.*
	Blue ash	*F. quadrangulata.*
	Pumpkin ash	*F. tomentosa.*
Basswood	American basswood (related species)	*Tilia americana.*
Beech	American beech	*Fagus grandifolia.*
Birch	River birch	*Betula nigra.*
	Sweet birch	*B. lenta.*
	Yellow birch	*B. lutea.*
Buckeye	Ohio buckeye	*Aesculus glabra.*
	Yellow buckeye	*A. octandra.*
Butternut	Butternut	*Juglans cinerea.*
Cherry	Black cherry	*Prunus serotina.*
	Pin cherry	*P. pensylvanica.*
	Common chokecherry	*P. virginiana.*
Chestnut	American chestnut	*Castanea dentata.*
Cottonwood	Eastern cottonwood	*Populus deltoides.*
	Swamp cottonwood	*P. heterophylla.*
	Bigtooth aspen	*P. grandidentata.*
Dogwood	Flowering dogwood	*Cornus florida.*
Elm, soft	American elm	*Ulmus americana.*
	Winged elm	*U. alata.*
	Slippery elm	*U. fulva.*
Gum, black	Black tupelo (blackgum)	*Nyssa sylvatica.*
Gum, red	Sweetgum	*Liquidambar styraciflua.*
Hackberry	Hackberry	*Celtis occidentalis.*
	Sugarberry	*C. laevigata.*
Hickory	Water hickory	*Carya aquatica.*
	Carolina hickory	*C. carolinae-septentrionalis.*
	Bitternut hickory	*C. cordiformis.*
	Pignut hickory	*C. glabra.*
	Shellbark hickory	*C. laciniosa.*
	Red hickory	*C. ovalis.*
	Shagbark hickory	*C. ovata.*
	Mockernut hickory	*C. tomentosa.*
Holly	American holly	*Ilex opaca.*
Honeylocust	Honeylocust	*Gleditsia triacanthos.*
Hornbeam	American hornbeam	*Carpinus caroliniana.*
Ironwood	Eastern hophornbeam	*Ostrya virginiana.*
Locust	Black locust	*Robinia pseudoacacia.*
Magnolia	Cucumbertree	*Magnolia acuminata.*
	Fraser magnolia	*M. fraseri.*
	Sweetbay	*M. virginiana.*
Maple, hard	Sugar maple	*Acer saccharum.*
Maple, soft	Silver maple	*A. saccharinum.*
	Red maple	*A. rubrum.*
Mulberry	Red mulberry	*Morus rubra.*

Lumber or trade name	*Recognized common name*	*Botanical name*
Oak, red	Black oak	*Quercus velutina.*
	Blackjack oak	*Q. marilandica.*
	Northern red oak	*Q. borealis.*
	Pin oak	*Q. palustris.*
	Scarlet oak	*Q. coccinea.*
	Shingle oak	*Q. imbricaria.*
	Shumard oak	*Q. shumardii.*
	Southern red oak	*Q. falcata.*
	Swamp red oak	*Q. falcata* var. *pagodaefolia.*
	Water oak	*Q. nigra.*
	Willow oak	*Q. phellos.*
Oak, white	Bur oak	*Q. macrocarpa.*
	Chestnut oak	*Q. montana.*
	Chinquapin oak	*Q. muehlenbergii.*
	Live oak	*Q. virginiana.*
	Overcup oak	*Q. lyrata.*
	Post oak	*Q. stellata.*
	Swamp chestnut oak	*Q. prinus.*
	Swamp white oak	*Q. bicolor.*
	White oak	*Q. alba.*
Persimmon	Common persimmon	*Diospyros virginiana.*
Redbud	Eastern redbud	*Cercis canadensis.*
Sassafras	Sassafras	*Sassafras albidum.*
Silverbell	Carolina silverbell	*Halesia carolina.*
Sourwood	Sourwood	*Oxydendrum arboreum.*
Sycamore	American sycamore	*Platanus occidentalis.*
Tupelo	Water tupelo	*Nyssa aquatica.*
	Swamp tupelo	*N. sylvatica* var. *biflora.*
Walnut	Black walnut	*Juglans nigra.*
Willow	Black willow	*Salix nigra.*
Yellow-poplar	Yellow-poplar	*Liriodendron tulipifera.*

Data by Physiographic Provinces

The following tables present area, volume, increment, and drain statistics for the three major physiographic provinces of Virginia. They provide a convenient means of appraising and comparing the general forest situation in these distinct divisions of the State.

TABLE 25.—*Commercial forest area by physiographic province, forest type group, and forest condition, 1940*

Province and forest condition	Loblolly pine [1]	Shortleaf pine [2]	Virginia pine	White pine [3]	Bottom-land hardwoods [4]	Cove hardwoods [5]	Upland hardwoods	Total softwoods		Total hardwoods [4]		Total all species	
Coastal Plain:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Saw timber	1,279,600	94,100	172,200		409,700		521,500	1,545,900	64	931,200	62	2,477,100	63
Cordwood	548,800	65,200	135,200		160,100		367,000	749,200	31	527,100	35	1,276,300	33
Reproduction	91,000	4,800	23,400		37,800		8,800	119,200	5	46,600	3	165,800	4
All conditions	1,919,400	164,100	330,800		607,600		897,300	2,414,300	100	1,504,900	100	3,919,200	100
Piedmont:													
Saw timber	49,500	681,600	474,500	27,200	192,500	95,700	1,189,700	1,232,800	45	1,477,900	48	2,710,700	47
Cordwood	31,600	480,700	731,200	8,800	129,600	54,000	1,272,100	1,252,300	45	1,455,700	47	2,708,000	46
Reproduction	15,300	70,800	185,800		12,000		125,300	271,900	10	137,300	5	409,200	7
All conditions	96,400	1,233,100	1,391,500	36,000	334,100	149,700	2,587,100	2,757,000	100	3,070,900	100	5,827,900	100
Mountain:													
Saw timber		234,800	71,500	138,700	8,100	221,100	1,292,800	445,000	42	1,522,000	42	1,967,000	42
Cordwood		324,500	174,500	59,800	17,000	184,400	1,808,800	558,800	53	2,010,200	56	2,569,000	55
Reproduction		14,600	39,100	1,600	800	3,300	69,500	55,300	5	73,600	2	128,900	3
All conditions		573,900	285,100	200,100	25,900	408,800	3,171,100	1,059,100	100	3,605,800	100	4,664,900	100
State:													
Saw timber	1,329,100	1,010,500	718,200	165,900	610,300	316,800	3,004,000	3,223,700	52	3,931,100	48	7,154,800	50
Cordwood	580,400	870,400	1,040,900	68,600	306,700	238,400	3,447,900	2,560,300	41	3,993,000	49	6,553,300	45
Reproduction	106,300	90,200	248,300	1,600	50,600	3,300	203,600	446,400	7	257,500	3	703,900	5
All Conditions	2,015,800	1,971,100	2,007,400	236,100	967,600	558,500	6,655,500	6,230,400	100	8,181,600	100	14,412,000	100
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*						
	14.0	13.7	13.9	1.6	6.7	3.9	46.2		43.2		56.8		100

[1] Includes pond pine, 12,100 acres.
[2] Includes redcedar-hardwoods, 61,600 acres.
[3] Includes hemlock, 74,400 acres.
[4] Includes cypress, 24,900 acres; white-cedar, 11,300 acres; and stream-margin hardwoods, 25,900 acres.
[5] Includes northern hardwoods, 128,400 acres.

TABLE 26.—*Net saw-timber volume*[1] *(International ¼-inch log rule), by species and physiographic province, 1940*

Species	Coastal Plain	Piedmont	Mountain	State	Species	Coastal Plain	Piedmont	Mountain	State
Softwoods:	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	Hardwoods—Continued	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*
Loblolly pine [2]	6,839,400	220,000		7,059,400	White oak	363,000	843,300	696,300	1,902,600
Shortleaf pine [3]	450,000	1,753,900	509,600	2,713,500	Chestnut oak	15,700	353,200	804,700	1,173,600
Virginia pine	352,500	1,058,400	130,600	1,541,500	Other white oaks	35,400	65,200	7,400	108,000
White pine		85,600	328,300	413,900	Birch			37,300	37,300
Hemlock		11,700	240,000	251,700	Beech	223,600	62,100		285,700
Redcedar	10,500	19,300	11,400	41,200	Hickory	145,200	254,600	236,100	635,900
White-cedar	64,900			64,900	Cherry, walnut			50,200	50,200
Cypress	201,900			201,900	Sugar maple			96,500	96,500
					Ash	91,800	54,700	29,700	176,200
Total	7,919,200	3,148,900	1,219,900	12,288,000	Other hardwoods	177,900	271,500	250,400	699,800
Hardwoods:					Total	3,828,800	4,461,500	3,755,900	12,046,200
Red maple	221,900	108,400	62,500	392,800					
Blackgum	648,200	78,800	120,600	847,600	All live species	11,748,000	7,610,400	4,975,800	24,334,200
Sweetgum	777,900	243,300		1,021,200	Dead chestnut			758,400	758,400
Yellow-poplar	529,700	1,002,200	348,000	1,879,900					
Northern red oak	152,200	437,700	474,200	1,064,100	All species	11,748,000	7,610,400	5,734,200	25,092,600
Other red oaks	446,300	686,500	542,000	1,674,800					

[1] Figures include board-foot volume in cordwood stands.
[2] Includes pond pine, 3,500 M board feet.
[3] Includes pitch pine in Mountain province.

TABLE 27.—*Distribution of net saw-timber volume in each physiographic province, by species and tree-diameter class, 1940*

Species	Coastal Plain			Piedmont			Mountain		
	10–12 inches	14–18 inches	20+ inches	10–12 inches	14–18 inches	20+ inches	10–12 inches	14–18 inches	20+ inches
Softwoods:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Loblolly pine	40.2	45.7	14.1	49.3	43.1	7.6			
Shortleaf pine	61.7	33.4	4.9	63.2	31.3	5.5	50.4	39.3	10.3
Virginia pine	57.8	39.1	3.1	74.3	25.1	.6	79.9	20.1	
White pine				30.1	35.3	34.6	28.0	40.1	31.9
Hemlock				32.5	41.9	25.6	13.0	31.8	55.2
Redcedar	61.0	31.4	7.6	92.7	7.3		69.3	30.7	
White-cedar	10.9	45.4	43.6						
Cypress	27.7	43.7	28.6						
Total	41.7	44.6	13.7	65.2	30.0	4.8	40.4	35.9	23.7
Hardwoods:									
Red maple		65.5	34.5		70.5	29.5		54.2	45.8
Blackgum		56.5	43.5		78.0	22.0		63.9	36.1
Sweetgum		70.0	30.0		75.4	24.6			
Yellow-poplar		60.0	40.0		63.7	36.3		56.2	43.8
Northern red oak		31.9	68.1		37.1	62.9		43.8	56.2
Other red oaks		54.7	45.3		58.1	41.9		67.2	32.8
White oak		61.2	38.8		53.9	46.1		42.0	58.0
Chestnut oak		43.3	56.7		51.6	48.4		48.1	51.9
Other white oaks		65.3	34.7		70.2	29.8		68.9	31.1
Birch								61.1	38.9
Beech		52.2	47.8		73.1	26.9			
Hickory		63.6	36.4		71.8	28.2		63.4	36.6
Cherry, walnut								62.2	37.8
Sugar maple								40.6	59.4
Ash		68.7	31.3		79.5	20.5		64.6	35.4
Other hardwoods		61.7	38.3		60.2	39.8		58.3	41.7
Total		60.1	39.9		59.1	40.9		52.5	47.5
All live species	28.1	49.7	22.2	26.9	47.1	26.0	9.9	48.4	41.7
Dead chestnut								49.7	50.3
All species	28.1	49.7	22.2	26.9	47.1	26.0	8.6	48.6	42.8

TABLE 28.—*Distribution of saw-timber area and volume in each physiographic province, by volume-per-acre class, 1940*

Volume per acre in board feet	Coastal Plain		Piedmont		Mountain		State		Volume per acre in board feet	Coastal Plain		Piedmont		Mountain		State	
	Area	Volume	Area	Volume	Area	Volume	Area	Volume		Area	Volume	Area	Volume	Area	Volume	Area	Volume
Softwood:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	Hardwood:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Less than 2,000	28.0	6.9	48.1	21.1	61.0	27.6	40.2	12.5	Less than 2,000	37.9	12.8	53.1	24.2	60.3	29.1	52.4	22.2
2,000–3,999	25.4	14.2	31.5	32.5	22.5	25.6	27.3	20.1	2,000–3,999	30.8	24.2	28.8	31.3	24.3	29.6	27.5	28.6
4,000–5,999	15.4	14.7	12.9	23.0	7.9	15.4	13.4	17.0	4,000–5,999	14.8	19.5	11.3	21.4	8.9	18.4	11.2	19.8
6,000–7,999	11.2	15.1	4.4	11.0	4.9	14.3	7.7	13.9	6,000–7,999	7.4	13.7	3.4	9.0	3.7	11.0	4.4	11.1
8,000–9,999	7..	12.5	1.8	6.1	1.7	6.0	4.5	10.2	8,000–9,999	3.6	8.6	1.5	5.2	2.0	7.8	2.2	7.1
10,000+	12.7	36.6	1.3	6.3	2.0	11.1	6.9	26.3	10,000+	5.5	21.2	1.9	8.9	.8	4.1	2.3	11.2

TABLE 29.—*Net cordwood volume of all live timber in each physiographic province, by species group and class of material, 1940*[1]

Species group and class of material	Coastal Plain	Piedmont	Mountain	State
Softwoods:				
Sawlog-size trees:	*1,000 cords*	*1,000 cords*	*1,000 cords*	*1,000 cords*
Sawlog material	19,497.8	8,778.8	3,006.2	31,282.8
Upper stems	4,289.0	2,566.2	795.1	7,650.3
Sound trees under sawlog size	9,369.0	10,357.7	1,883.0	21,609.7
Cull trees	991.9	1,298.9	749.1	3,039.9
Total	34,147.7	23,001.6	6,433.4	63,582.7
Hardwoods:				
Sawlog-size trees:	*1,000 cords*	*1,000 cords*	*1,000 cords*	*1,000 cords*
Sawlog material	10,125.8	12,454.7	10,418.3	32,998.8
Upper stems and limbs	5,801.4	6,931.2	5,630.9	18,363.5
Sound trees under sawlog size	16,887.2	23,436.1	13,234.7	53,558.0
Cull trees	7,365.1	6,853.4	12,175.9	26,394.4
Total	40,179.5	49,675.4	41,459.8	131,314.7
All species	74,327.2	72,677.0	47,893.2	194,897.4

[1] Does not include dead chestnut.

TABLE 30.—*Net cubic-foot volume of all sound wood, by species and class of material, 1940*[1]

Species	Saw-timber trees: Sawlogs	Saw-timber trees: Upper stems	Under sawlog-size trees	Cull trees	All material
Softwoods:	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Loblolly pine	1,213.4	254.9	475.6	44.6	1,988.5
Shortleaf pine	531.9	152.5	476.8	46.7	1,207.9
Virginia pine	305.0	89.5	447.4	103.0	944.9
White pine	71.6	15.3	23.2	10.2	120.3
Hemlock	45.1	8.6	8.0	6.9	68.6
Redcedar	7.9		20.0	.2	28.1
White-cedar	12.0	.9	.4		13.3
Cypress	37.1	9.0	7.1	6.7	59.9
Total	2,224.0	530.7	1,458.5	218.3	4,431.5
Hardwoods:					
Red maple	73.1	37.7	141.2	178.0	430.0
Blackgum	159.8	74.5	169.7	163.0	567.0
Sweetgum	167.8	87.6	311.8	73.6	640.8
Yellow-poplar	315.8	149.3	381.8	82.5	929.4
Northern red oak	178.7	92.1	110.2	79.0	460.0
Other red oaks	313.0	150.7	563.2	157.4	1,184.3

Species	Saw-timber trees: Sawlogs	Saw-timber trees: Upper stems	Under sawlog-size trees	Cull trees	All material
Hardwoods—Continued	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
White oak	342.7	167.4	600.0	156.3	1,266.4
Chestnut oak	221.7	103.6	277.6	319.5	922.4
Other white oaks	21.3	9.6	71.2	26.8	128.9
Birch	7.0	3.6	14.2	19.6	44.4
Beech	52.8	28.3	40.8	37.7	159.6
Hickory	126.4	58.7	221.1	60.7	466.9
Cherry, walnut	8.7	3.8	10.8	5.3	28.6
Sugar maple	17.7	9.4	10.6	21.3	59.0
Ash	29.8	13.9	65.8	40.0	149.5
Dogwood				74.7	18.3	93.0
Black locust				61.0	10.1	71.1
Other merchantable hardwoods	129.0	64.5	180.9	153.1	527.5
Scrub hardwoods				82.9	82.9
Total	2,165.3	1,054.7	3,306.6	1,685.1	8,211.7
All species[2]	4,389.3	1,585.4	4,765.1	1,903.4	12,643.2

[1] Volumes shown represent State average for the year. In Coastal Plain and southern Piedmont they are as of Jan. 1; in the northern Piedmont and mountains they are as of Dec. 31.

[2] Excludes chestnut.

TABLE 31.—*Net cubic-foot increment of all sound trees 5.0 inches d. b. h. and larger, by species group and province, 1945*

Species group	Coastal Plain	Piedmont	Mountain	State
Softwoods:	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Virginia pine	13,610	65,750	7,841	87,201
Other yellow pines	115,362	50,874	6,295	172,531
Other softwoods	1,466	3,593	6,571	11,630
Total softwoods	130,438	120,217	20,707	271,362
Hardwoods:	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Oaks	29,619	55,125	37,230	121,974
Gums and yellow-poplar	40,409	43,552	10,000	93,961
Other hardwoods	17,103	31,262	28,557	76,922
Total hardwoods	87,131	129,939	75,787	292,857
All species	217,569	250,156	96,494	564,219

TABLE 32.—*Net cubic-foot drain on all sound trees 5.0 inches d. b. h. and larger, by species group and province, 1945*

Species group	Coastal Plain	Piedmont	Mountain	State	Species group	Coastal Plain	Piedmont	Mountain	State
Softwoods:	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	Hardwoods:	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Virginia pine	9,109	25,633	3,160	37,902	Oaks	17,912	33,914	29,704	81,530
Other yellow pines	79,569	45,766	6,305	131,640	Gums and yellow-poplar	11,029	14,373	7,217	32,619
Other softwoods	1,858	4,376	6,427	12,661	Other hardwoods	3,485	8,894	12,169	24,548
Total softwoods	90,536	75,775	15,892	182,203	Total hardwoods	32,426	57,181	49,090	138,697
					All species	122,962	132,956	64,982	320,900

TABLE 33.—*Net change in cubic-foot volume of total growing stock, Jan. 1, 1940, to Jan. 1, 1946*

Item	Softwoods				Hardwoods				All species
	Virginia pine	Other yellow pines	Other softwoods	Total softwoods	Oaks	Gums and yellow-poplar	Other hardwoods	Total hardwoods	
Growing stock, Jan. 1, 1940:	*M cu. ft.*	*M cu. ft.*	*M. cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Coastal Plain	158,290	2,047,430	62,980	2,266,700	567,600	766,800	381,580	1,715,980	3,982,680
Piedmont	589,070	868,250	43,020	1,500,340	1,193,830	573,890	465,570	2,233,290	3,733,630
Mountain	77,590	189,500	149,860	416,950	915,400	153,140	396,890	1,465,430	1,882,380
Total	822,950	3,105,180	255,860	4,183,990	2,676,830	1,493,830	1,244,040	5,414,700	9,598,690
Growing stock, Jan. 1, 1946:									
Coastal Plain	166,990	2,143,250	51,590	2,361,830	627,000	918,820	454,870	2,000,690	4,362,520
Piedmont	770,550	801,030	49,420	1,621,000	1,308,910	722,540	591,480	2,622,930	4,243,930
Mountain	100,990	189,290	151,030	441,310	952,550	169,420	486,350	1,608,320	2,049,630
Total	1,038,530	3,133,570	252,040	4,424,140	2,888,460	1,810,780	1,532,700	6,231,940	10,656,080
Net change, Jan. 1, 1940, to Jan. 1, 1946:									
Coastal Plain	+10,700	+95,820	−11,390	+95,130	+59,400	+152,020	+73,290	+284,710	+379,840
Piedmont	+181,480	−67,220	+6,400	+120,660	+115,080	+148,650	+125,910	+389,640	+510,300
Mountain	+23,400	−210	+1,170	+24,360	+37,150	+16,280	+89,460	+142,890	+167,250
Total	+215,580	+28,390	−3,820	+240,150	+211,630	+316,950	+288,660	+817,240	+1,057,390
Percentage change, Jan. 1, 1940, to Jan. 1, 1946:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Coastal Plain	+6.8	+4.7	−18.1	+4.2	+10.5	+19.8	+19.2	+16.6	+9.5
Piedmont	+30.8	−7.7	+14.9	+8.0	+9.6	+25.9	+27.0	+17.4	+13.7
Mountain	+30.2	−.1	+.8	+5.8	+4.1	+10.6	+22.5	+9.8	+8.9
All provinces	+26.2	+.9	−1.5	+5.7	+7.9	+21.2	+23.2	+15.1	+11.0

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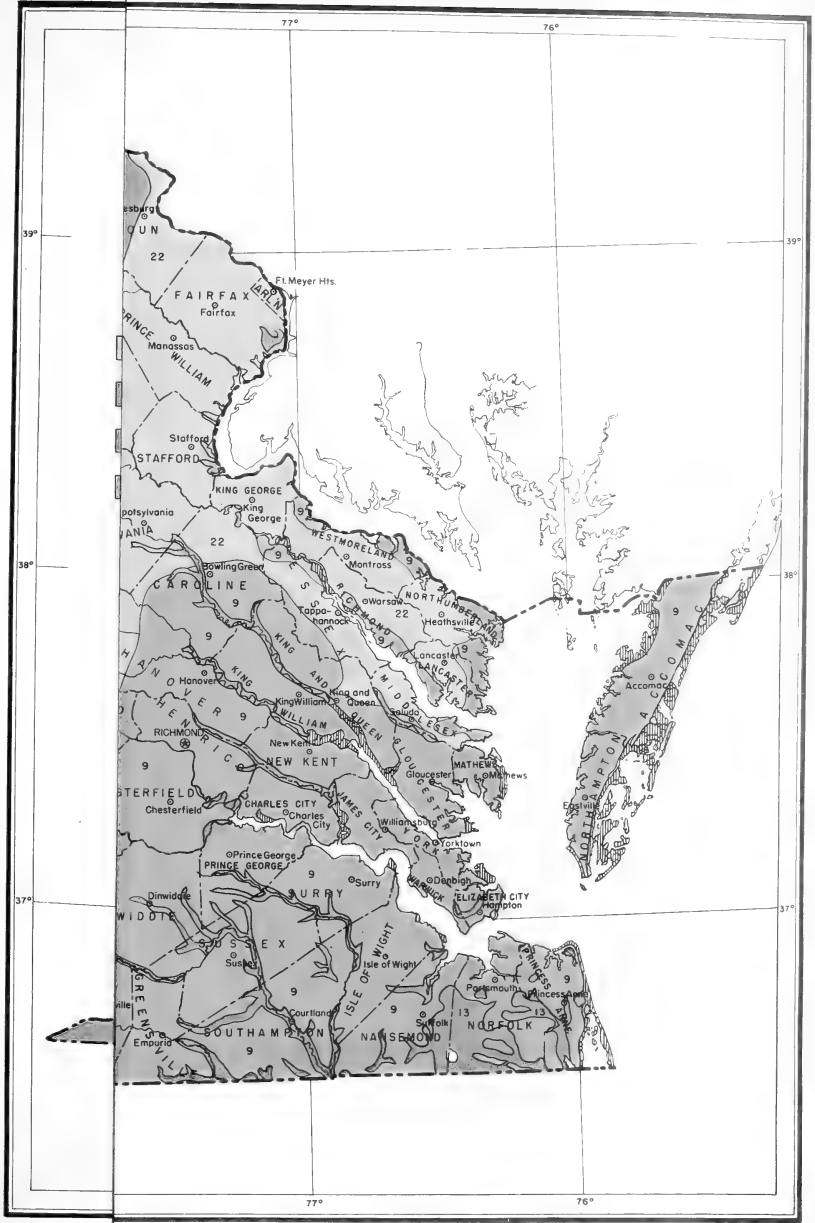
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KING GEORGE
King George
WESTMORELAND
Montross
Bowling Green
CAROLINE
Warsaw
NORTHUMBERLAND
Heathsville
Lancaster
LANCASTER
Hanover
KING AND QUEEN
King William
KING WILLIAM
RICHMOND
New Kent
NEW KENT
Gloucester
MATHEWS
Mathews
Chesterfield
CHARLES CITY
Charles City
JAMES CITY
Williamsburg
Yorktown
YORK
Prince George
PRINCE GEORGE
Surry
Denbigh
WARWICK
ELIZABETH CITY
Hampton
Dinwiddie
SUSSEX
Isle of Wight
ISLE OF WIGHT
Courtland
Suffolk
NANSEMOND
Portsmouth
NORFOLK
Emporia
SOUTHAMPTON
Accomack
NORTHAMPTON
Eastville

MAJOR FOREST TYPES
STATE OF VIRGINIA
1941

LEGEND

7 SHORTLEAF PINE - HARDWOODS	22 VIRGINIA PINE - HARDWOODS
9 LOBLOLLY PINE - HARDWOODS	23 SHORTLEAF - PITCH PINE - HARDWOODS
11 MOUNTAIN HARDWOODS	24 WHITE PINE - HARDWOODS
13 BOTTOM-LAND HARDWOODS	MARSH OR BEACH

Type symbols show areas where the major types predominate. No attempt has been made to delineate minor types or agricultural land.

SCALE IN MILES
10 0 10 20 30 40